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VOL. V JULY, 1951 NO. 3

PACIFIC SCIENCE

A QUARTERLY DEVOTED TO THE BIOLOGICAL AND PHYSICAL SCIENCES OF THE PACIFIC REGION

IN THIS ISSUE: Knight and Hull — Aedes *Mosquitoes of the Philippine Islands* • Kartman — *Notes on a* Tetrameres *Parasite of the English Sparrow* • de Laubenfels — *Sponges of the Island of Hawaii* • Gosline — *The Scientific Name of the Nehu* • Tuthill — *Some Micronesian Psyllidae* • St. John — *Plant Records from Aur Atoll and Majuro Atoll* • NOTES

Published by
THE UNIVERSITY OF HAWAII
HONOLULU, HAWAII

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Previous issue published May 3, 1951

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PACIFIC SCIENCE, a quarterly publication of the University of Hawaii, appears in January, April, July, and October. Subscription price is three dollars a year; single copies are one dollar. Check or money order payable to University of Hawaii should be sent to PACIFIC SCIENCE, Office of Publications, University of Hawaii, Honolulu 14, Hawaii. Reprints of articles from Volumes I and II are available to subscribers.

The *Aedes* Mosquitoes of the Philippine Islands[1]

I. Keys to Species. Subgenera *Mucidus, Ochlerotatus,* and *Finlaya* (Diptera, Culicidae)

KENNETH L. KNIGHT AND WILLIAM B. HULL[2]

INTRODUCTION

EXTENSIVE COLLECTIONS of mosquitoes made in the Philippines during the last war have resulted in a great increase in our knowledge of the culicid fauna of that island group. This has been particularly true for the genus *Aedes*. In 1945 Bohart listed 34 *Aedes* species for the Philippines, of which only 6 were known in the larval stage from Philippine specimens. The present series of three papers, of which this is the first part, treats 74 named species and subspecies, and Philippine larval specimens were seen for 56 of these.

Material Used

This study has been based primarily upon the collection made from April to October, 1945, by a branch unit of U. S. Naval Medical Research Unit No. 2 (NAMRU–2) on the islands of Luzon, Leyte, Samar, Palawan, Balabac, Culion, Busuanga, Mindanao, Basilan, and Jolo. This collection, consisting very largely of adults associated with their larval and pupal skins, was gathered by L. E. Rozeboom, K. L. Knight, J. L. Laffoon, and D. R. Johnson. In addition, numerous non-technical service personnel contributed considerably to the task.

The second largest source of material studied was the collection of the U. S. National Museum, which is particularly rich in Philippine type specimens. Before the last war, the Philippine mosquito collection of the National Museum consisted principally of material collected by the U. S. military occupation forces following the Spanish-American War and contributed by them through C. S. Ludlow. The only other important source during this period was the collecting of C. S. Banks. He sent excellent material of many species to both the British Museum and the National Museum, but retained most of the types in Manila, where they were all destroyed in the seizure of that city by the Allied forces in World War II. Following World War II, several collections of mosquitoes from the Philippines were deposited in the National Museum. Important among these contributions are those of H. Hoogstraal, K. V. Krombein, S. E. Shields, J. H. Paullus, J. T. Medler, and A. B. Gurney.

Additional important collections, all made during World War II, that were drawn upon for this paper are those of the Academy of Natural Sciences of Philadelphia, collected by H. R. Roberts; the California Academy of Sciences, collected by E. S. Ross; and Cornell University, collected by J. G. Franclemont. Representative portions of the *Aedes* collection of the Philippine Bureau of Health (made by F. E. Baisas and his associates) were also drawn upon.

A number of the types of Philippine species occur in the British Museum and these were all extensively studied and compared by the senior author in 1946.

[1]The opinions or conclusions contained herein are those of the authors and are not to be construed as official or reflecting the views of the Navy Department or of the naval service at large. Manuscript received November 27, 1950.

[2]Naval Medical Research Institute, Bethesda, Maryland. Lieutenant Commander, MSC, USN, now with Naval Medical Research Unit No. 3, Cairo, Egypt; and Lieutenant, MSC, USN, respectively.

Explanations

In the period from 1946 to 1951, the following series of 10 papers was published on Philippine *Aedes* species (48 in all) contained in the NAMRU-2 collection: Knight and Rozeboom (1946), Laffoon (1946), Knight (1946), Knight and Laffoon (1946), Rozeboom (1946), Knight (1947, 1947*a*, 1947*b*, 1948), and Knight and Hull (1951). Because of the limitations of space and to avoid extensive duplication, the descriptive and biological sections and the illustrations for all the species treated in the above series of papers are omitted from this present work.

The specimens in the NAMRU–2 collection of the remaining Philippine *Aedes* species are here reported for the first time. The bulk of the collection used for the previously published treatments is deposited in the National Museum and is listed in the distribution section for each species following the heading, U.S.N.M. The published records of this material are not included under "Literature Record" of distribution, except for the subgenus *Aedes*. The material not previously published is given after the heading, R.K.L. The names of collectors and the number of specimens included have been omitted from those records which have been previously published. In a few other cases, the number of included specimens has been omitted because it is no longer available.

In general, the morphological descriptive terminology employed here is that used and explained by Carpenter, Middlekauff, and Chamberlain (1946). However, several departures from this terminology have been made. Chief among these are the following: the treatment of the paratergite as a pleural sclerite instead of a mesonotal structure, where it morphologically belongs (this has been done for convenience since it is more easily noted when an examination of the pleural sclerites is being made); the use of the term meteusternum for the area designated by them as the metameron; the use of Marshall's (1938: 40) larval head hair numerical nomenclature; and the listing of the larval eighth abdominal segment hairs in dorsal-ventral order with Arabic numerals.

Subgeneric synonyms are given only in those cases where they were first applied to a species that occurs in the Philippines. The subgeneric descriptions apply specifically only to Philippine species.

Unless otherwise stated, the data included under bionomics are those gathered in the formulation of the NAMRU–2 collection.

The figures in this paper were not drawn to scale. Illustrations marked with the initials WBH were made by the junior author.

A dagger (†) in the synonymy sections denotes types that have been examined by us.

The following abbreviations are used in the descriptions. Adult: *apn*—anterior pronotal lobe; *ppn*—posterior pronotal lobe. Larva: *isc*—inner or upper caudal hair of the anal segment; *osc*—outer or lower caudal hair of anal segment; *lh*—lateral hair on anal plate.

The following abbreviations are used in the species distribution sections to denote the present locations of specimens examined. A.N.S.P.—Academy of Natural Sciences of Philadelphia; C.A.S.—California Academy of Sciences; U.S.N.M.—U. S. National Museum; B.M.—British Museum (Natural History); C.C.—Cornell University; R.K.L.—specimens from the collection of Naval Medical Research Unit No. 2 on which nothing has been previously published and which are now deposited in the U. S. National Museum, the Johns Hopkins University, the Knight collection, the California Academy of Sciences, and the British Museum.

To obtain uniformity in the listing of the distribution of each species, the *Gazetteer to Maps of the Philippine Islands*, second edition, 1944, published by the Army Map Service, Corps of Engineers, U. S. War Department, has been used for the spelling of all place names. The islands of Luzon, Cebu, Panay, Negros, and Mindanao are divided into provinces, and in nearly every case distribu-

FIG. 1. Outline map of the Philippine Islands.

tion records from these islands include the name of the province.

It will be noted that this work, in conformity with American usage, omits the diaeresis from the word *Aedes*. This policy has been followed on the basis that since Meigen (1818:13) did not use the diaeresis in his original citation of the name it is not mandatory for subsequent users to employ it. Nor is it mandatory to follow a subsequent correction established on the basis of a supposed *lapsus calami*. It is true that in the index of the book containing the original reference to *Aedes* (p. 325) the first two letters are written as a diphthong, but it is quite open to question that Meigen prepared the index. Following the policy described above, the diaeresis has also been omitted from *Aedimorphus*, but has been used with *Cancraëdes*.

Acknowledgments

We are indebted to the late Captain E. G.

Hakansson, MC, USN, for the initiation of this project, and to Captain C. F. Behrens, MC, USN, and Captain A. R. Behnke, MC, USN, for their continuing support of the work. The senior author wishes to express his sincere appreciation to Captain J. J. Sapero, MC, USN, for permission to complete this work after coming to his command at U. S. Naval Medical Research Unit No. 3.

For the invaluable privilege of examining material we wish to thank the following: Dr. Alan Stone, National Museum; Dr. H. R. Roberts, Academy of Natural Sciences of Philadelphia; Dr. E. S. Ross, California Academy of Sciences; Mr. F. E. Baisas, Philippine Bureau of Health; Mr. H. Oldroyd, British Museum (Natural History); and Dr. Robert Matheson, Cornell University.

Portions of this work were done in space provided at the National Museum and at the British Museum through the courtesy of Dr. E. A. Chapin and Mr. N. D. Riley, respectively.

KEYS TO THE PHILIPPINE SPECIES OF *Aedes*

Adult Key

1. Tarsi all dark 2
   At least the hind tarsi with pale markings 30
2. Scutellar scales narrow 3
   Scutellar scales broad, or mostly so .. 17
3. Vertex dorsum, scutum, and scutellum with conspicuous yellow scaling 4
   Vertex dorsum, scutum, and scutellum largely dark-scaled, not with yellow scaling (*Aedes*) 5
4. Scutum with a broad area of yellow scales along lateral margin, central portion dark-scaled; wing with pale scaling along vein 1 to junction with stem of vein 2, on vein 5, and, in female, also on Sc. ..... (*Banksinella*) *lineatopennis*
   Scutum with narrow longitudinal medial and lateral lines of yellow scaling; wing dark-scaled ..... (?*Aedimorphus*) *ostentatio*
5. Abdominal tergites II–VIII always with some white or yellowish baso-lateral markings, sometimes produced onto dorsum or sometimes reduced to only a few scales; (hind claws simple) 6
   Abdominal tergites II–VIII entirely brown (in *dux* sometimes with lateral border grayish or sometimes with an indefinite baso-lateral patch of paler brown scales on last few only); (mesepimeron never with more than 4 hairs behind scale patch, none below; about 5–10 small upright-forked scales on nape on either side of mid-line; about 10–12 verticillate bristles on most antennal segments of male) 15
6. Anterior median portion of sternopleuron with 6 or more fine hairs; (sternites almost entirely white) .. 7
   Anterior median portion of sternopleuron bare of hairs or with only 1–2 (rarely up to about 8 very small hairs in *butleri* but this species with a considerable portion of the sternites brown-scaled and the scutal integument blackish-brown) 9
7. Male ninth tergite with a very large median Y-shaped process about as long as basistyle, each branch with an additional hairy branch on its sternal surface; female terminalia with atrial hairs confined to median area, preatrial plates not united ... (*Aedes*) *macrodixoa*
   Male ninth tergite without such a process; female terminalia with atrial hairs not confined to median area and preatrial plates united for greater part of their length (female of *nubicolus* unknown) 8
8. Basistyle with a group of about 8–9 stout spines apically on the inner sternal margin; paraproct short; two very long processes arising near apex of basistyle, one with 3–4 stout spines near tip ..... (*Aedes*) *uncus*
   Inner sternal margin of basistyle without a group of stout spines; paraproct longer than basistyle; a broad

process near apex of basistyle with a row of about 4 heavy spines apically..... (*Aedes*) *nubicolus*

9. Meteusternum with numerous fine hairs; basistyle with a group of about 8 stout spines on the inner sternal margin near the base; (male fore and mid legs with claws unequal, the larger ones uniserrate, the smaller simple)..... 10

Meteusternum without hairs; basistyle without such a group of spines..... 12

10. Apico-tergal prolongation of basistyle very wide, its 2 distal forks about equal in length; only 2 other long apical processes, sometimes a more sternal short spine also visible..... (*Aedes*) *adustus*[3]

Apico-tergal prolongation of basistyle otherwise; three other long apical or subapical processes present.... 11

11. Apico-tergal prolongation of basistyle very wide..... (*Aedes*) *johnsoni*[3]

Apico-tergal prolongation of basistyle much narrower..... (*Aedes*) *margarsen*[3]

12. Mesepimeron with at least 2 hairs below scale patch, usually more numerous..... 13

Mesepimeron with a number of bristles along upper margin but with no hairs ventral to scale patch and never more than 3–4 behind it.... 14

13. Upper sternopleural scale patch usually extending to anterior median angle of sclerite; abdominal sternites II–VII with a wide basal white band, covering at least basal one-half of each segment; male with claws of fore and mid legs equal and toothed, and dististyle simple; female with postatrial sclerite not trilobed.... ..... (*Aedes*) *panayensis*

Upper sternopleural scale patch never extending to the anterior median angle of sclerite; sternites entirely dark brown or with some white scales on basal one-third; male with claws of fore leg unequal, toothed, claws of mid leg unequal, simple, and dististyle forked; female with postatrial sclerite trilobed..... ..... (*Aedes*) *butleri*

14. Scutal integument dark reddish-brown; sternites II–VII with about basal two-thirds of each segment white; male with smaller claws of fore and mid legs each with a small tooth, basistyle with a large patch of flat white scales laterally, and the paraproct forked beyond the middle; female without a large round dark preatrial plate in addition to the paired preatrial plates..... ..... (*Aedes*) *campylostylus*

Scutal integument blackish-brown; sternites II–VII brown; male with smaller claws of fore and mid legs simple, basistyle with flat brown scales only, and the paraproct simple; female with a large round heavily pigmented preatrial plate in addition to the paired preatrial plates..... (*Aedes*) *nigrotarsis*

15. Hind claws simple in both sexes; female with a pair of hairy processes anterior to the spermathecal eminence..... (*Aedes*) *dux*

Hind claws unidentate in both sexes; female without paired hairy processes anterior to the spermathecal eminence..... 16

16. Male with larger claw of mid leg simple, smaller claws of fore and mid legs each with a small tooth (females of this and of the following species indistinguishable except on details of the postatrial area; see Laffoon, 1946: 232).. (*Aedes*) *hamistylus*

Male with larger claw of mid leg with a prominent tooth, smaller claws of fore and mid legs simple..... ..... (*Aedes*) *robertsi*

17. *Ppn* largely clothed with broad overlapping silvery scales; (paratergite with a patch of broad silvery scales) ..... (*Finlaya*) *paradissimilis*[4]

[3]These three species are separable only on details of the male terminalia.

[4]This group of species is separable only on a combination of larval and male terminalic characters which are discussed in the species treatments.

. . . . . (*Finlaya*) *leucopleurus*
. . . . . (*Finlaya*) *luzonensis*
. . . . . (*Finlaya*) *leucomeres*

Ppn not clothed with broad overlapping silvery scales 18

18. Scutum with prominent anterior white scaling 19

Scutum without anterior white scaling, or, if present, occurring only in small spots 22

19. Scutal white-scaled area in female not extending to lateral margin over most of paratergite; male with a line of short stiff curved setae along inner tergal margin of basistyle, followed laterally by a line of thinner setae; baso-tergal scale clump of basistyle with scales narrow, elongate, and mostly of rather uniform length; claspette filament only slightly swollen medially and of uniform texture . . . . (*Finlaya*) *laoagensis*

Scutal white-scaled area in female extending along lateral margin to wing base, or at least to level of prealar region; male terminalia without the above combination of characters 20

20. Mid femur of female with a median elongate silvery-scaled area on the ventral half of the anterior surface; baso-tergal portion of basistyle with a clump of long setae, none of them striated (one specimen had 2 setae with a very few striations) . . . . . (*Finlaya*) *saperoi*

Mid femur of female with anterior surface dark medially except possibly on extreme ventral margin; baso-tergal portion of basistyle with a clump of specialized scales (to be distinguished from normal abdominal type scales) 21

21. Baso-tergal scale clump of basistyle with some of the scales very broad, others slender and elongate; claspette filament distinctly enlarged medially, the enlarged portion clear . . . . . (*Finlaya*) *lacteus*[5]

Baso-tergal scale clump of basistyle with scales setiform; claspette filament evenly and only slightly swollen to middle, of uniform texture . . . . . (*Finlaya*) *niveus*[5]

22. Femora with anterior surface apically dark; scutellum dark-scaled 23

Femora with an apical white spot on the anterior surface, at least on mid and hind legs; scutellum pale-scaled (white or silvery) 28

23. Mesepimeron and meteusternum with a number of short fine brownish hairs present; (male palpi approximately 0.6–0.7 as long as the proboscis; mesepimeron with a patch of brownish-white scales) . . . . . (*Geoskusea*) *baisasi*

Mesepimeron and meteusternum without short fine hairs (however, *curtipes* possesses several long fine hairs just below mesepimeral scale patch) 24

24. Pleuron with a patch of broad white scales on propleuron and mesepimeron and with two patches present on the sternopleuron 25

Pleuron with a few translucent scales (mostly in a single patch), or bare . . 26

25. Mesepimeral scale patch confluent with the dorsal hair tuft; hind femur usually with pale scaling ventrally on basal half of anterior surface . . . . . (*Skusea*) *fumidus*

Mesepimeral scale patch not confluent with the dorsal hair tuft; hind femur darker-scaled anteriorly . . . . . (*Skusea*) *amesii*

26. First hind tarsal segment as long as, or slightly longer than, the hind tibia; acrostichal bristles present; no lower mesepimeral bristles . . . . (*Rhinoskusea*) *longirostris*

First hind tarsal segment shorter than hind tibia; acrostichal bristles absent; lower mesepimeral bristles present 27

27. Hind femur anteriorly dark; pleuron yellowish-brown; mesepimeron not with several fine hairs between the dorsal hair tuft and the lower me-

[5]These two species can only be separated on the basis of male terminalic and of larval characters.

sepimeral bristles..... .....(*Cancraëdes*) *miachaetessus*

Hind femur anteriorly with considerable pale scaling on basal half; pleuron grayish-brown to brown; mesepimeron with several fine pale hairs between dorsal hair tuft and lower mesepimeral bristles..... .....(*Cancraëdes*) *curtipes*

28. Scutum, femora, and tibiae with small spots of broad silvery scales; median area of vertex mainly with broad white and dark scales..... .....(*Aedimorphus*) *punctifemore*

Scutum, femora, and tibiae without spots of broad silvery scales; median area of vertex mainly with narrow-curved scales..... 29

29. Scutum uniformly scaled on dorsal surface; tibial apices creamy; pleural scale patches dull..... .....(*Aedimorphus*) *pampangensis*

Scutum variegated with indistinct spots of pale scaling; tibial apices with a white patch; pleural scale patches white..... .....(*Aedimorphus*) *alboscutellatus*

30. *Ppn* with 10–30 bristles; wing membrane surrounding crossveins clouded; (wings with intermixed pale and dark scaling; lower mesepimeral bristles present)..... 31

Ppn usually with less than 10 bristles; wing membrane not clouded around the crossveins..... 33

31. Scutum sparsely clothed with narrow yellow scales (some scattered brown scales may also be present); female palpi barely one-fourth as long as proboscis; a black and yellow species..... .....(*Mucidus*) *aurantius quadripunctis*

Scutum with several twisted tufts of erect long white scales; female palpi over one-half as long as proboscis; brown, white, and yellow species.. 32

32. Fore and mid tibiae with a well-developed median white band; fore tibia with apical white band not occupying more than 0.25 of length of segment.....(*Mucidus*) *ferinus*

Fore and mid tibiae without a median white band, occasionally a few pale scales present, however; apical 0.31 or more of fore tibia white-scaled .....(*Mucidus*) *laniger*

33. Wings profusely spotted with areas of pale and dark scaling; femora and tibiae spotted and ringed with pale scaling for nearly their whole length..... 34

Wings not profusely spotted with areas of pale and dark scaling; femora and tibiae not spotted and ringed with pale scaling..... 40

34. Species with yellow, white, and black scaling..... 35

Species with black and white scaling. 39

35. Prealar scale patch connected to the dorsal sternopleural patch by a narrow line of broad white scales, from the anterior margin of the dorsal sternopleural patch a similar line extends ventrally and posteriorly to medio-posterior sternopleural scale patch; larger claw of fore and mid male tarsi with a single basal tooth .....(*Finlaya*) *stonei*

Prealar scale patch not connected to dorsal sternopleural scale patch with a line of scales, nor is there a line of scales extending ventrally and posteriorly from the dorsal sternopleural patch; larger claw of fore and mid male tarsi bidentate.. 36

36. Male with pale hairs scattered over the dorsal aspect of most of the abdominal tergites; female tergites with pale hairs numerous basally and apically so that there appears to be a thick fringe of them at the junction of the tergites; (proboscis nearly always without apico-ventral black scales) .....(*Finlaya*) *luteus*

Male with pale hairs of tergites confined to lateral and apical margins; female tergites with only a sparse row of pale hairs at the junction of the tergites..... 37

37. Proboscis without apico-ventral black scales, occasionally a few scattered ones present; basistyle of male ter-

minalia without a tergal subapical scale tuft; (latero-dorsal margins of abdominal tergites II–IV of female dark-scaled, or with yellow scaling present as spots or irregular marks only, not as longitudinal markings; *ppn* with few or no black scales)... .....(*Finlaya*) *croceus*

Proboscis with a patch of apico-ventral dark scales; basistyle with a tergal subapical elongate scale tuft, in addition to the usual inner median sternally projecting tuft..... 38

38. Proboscis of male largely dark-scaled laterally and ventrally, except for a median pale band; subapical scale tuft of basistyle dusky; latero-dorsal margins of abdominal tergites II–IV of female with yellow scaling present as spots or irregular marks only.....(*Finlaya*) *medleri*

Proboscis of male with considerable pale scaling laterally and ventrally; subapical scale tuft of basistyle largely pale yellow; latero-dorsal margins of abdominal tergites II–IV of female with longitudinal streaks of yellow scaling..... .....(*Finlaya*) *flavipennis*

39. Lateral scutellar lobes covered with broad scales, these white except for a few apical dark ones; segment I of fore tarsus with some basal white scales.....(*Finlaya*) *poicilius*

Lateral scutellar lobes with narrow-curved yellowish scales; segment I of fore tarsus without basal white scales.....(*Finlaya*) *ananae*

40. Scutum marked with a pattern of several (3–5) narrow longitudinal white or yellow lines, one of the lines being median in position.... 41

Scutum not marked with a pattern of 3–5 narrow longitudinal pale lines. 47

41. Tarsi all dark except for a small baso-lateral white patch on hind tarsal I .....(*Stegomyia*) *aurotaeniatus*

Hind tarsi with basal white bands on at least first 3 segments..... 42

42. Postspiracular area not scaled; (hind tarsus with basal and apical bands on I–III, a basal band on IV, V dark or else pale above)..... .....(*Finlaya*) *aureostriatus*

Postspiracular area scaled..... 43

43. Hind tarsi with basal and apical white bands on I–IV, V all white dorsally; mid femora with a conspicuous longitudinal median white line anteriorly.....(*Finlaya*) *banksi*

Hind tarsi with basal white bands on I–III (rarely also on IV), V all dark; mid femora without an anterior median line..... 44

44. Scutum with median longitudinal pale line forked posteriorly at the prescutellar bare space..(*Finlaya*) *saxicola*

Scutum with median longitudinal pale line not forked posteriorly..... 45

45. Hind tarsi with the first 4 segments with basal white scaling..... .....(*Finlaya*) *sherki*

Hind tarsi with only the first 3 segments with basal white scaling.... 46[6]

46. Prealar scale patch continuous with the upper sternopleural scale patch .....(*Finlaya*) *jugraensis*

Prealar scale patch distinctly separated from the upper sternopleural scale patch.....(*Finlaya*) *abadsantosi*[7] .....(*Finlaya*) *burgosi*[7]

47. Scutellum with only narrow and narrow-curved scales..... 48

Scutellum mostly or entirely broad-scaled..... 51

48. Scutum with considerable areas of white scaling; vertex dorsum largely broad-scaled; (hind tarsal segments III–V dark)....(*Finlaya*) *melanopterus*

Scutum not white-scaled; vertex dorsum largely narrow-scaled..... 49

49. Hind femur anteriorly pale except for a dark apical portion and along the dorsal margin; proboscis dark-scaled; paratergite of female not scaled.....(*Banksinella*) *imprimens*

Hind femur anteriorly speckled with pale scaling; proboscis with evident

[6]Since the type description of *rizali* (Banks) is incomplete on a number of points, it has been impossible to take it beyond this point in the key.

[7]Separable only on male and larval characters.

pale scaling; paratergite of female scaled..... 50

50. Subspiracular area scaled; female torus with white scaling..... (*Aedimorphus*) *vexans nocturnus*

Subspiracular area without scales; female torus not scaled..... (*Ochlerotatus*) *vigilax ludlowi*

51. Hind femora anteriorly dark, marked with a complete broad white band just before the middle and with a wide ventro-apical white area; lateral scutellar lobes narrow-scaled... (*Finlaya*) *harperi*

Hind femora not marked as above; scutellum all broad-scaled..... 52

52. Vertex dorsum narrow-scaled, at least along the mid line; scutum brown-scaled, marked with a rather indefinite pattern of small clusters of yellowish scales; some of the hind tarsal segments with narrow apical yellowish bands..... (*Aedimorphus*) *mindoroensis*

Vertex dorsum mid line at least partially broad-scaled; scutum not scaled as above; hind tarsal segments not marked with apical yellowish bands..... 53

53. Vertex dorsum broad-scaled except for a diamond-shaped anterior area of narrow white scales medially; paratergite bare..... 54

Vertex dorsum all broad-scaled (may be a few narrow scales on nape and along eye margins); paratergite scaled (not in *platylepidus*)..... 59

54. All three lobes of scutellum largely covered with broad white scales... 55

Only mid scutellar lobe with broad white scales, lateral lobes covered with broad black scales.....57[8]

55. Median stripe of scutum extending posteriorly to the scutellum..... (*Stegomyia*) *bambusicolus*

Median stripe of scutum extending only to level of wing bases..... 56

56. An area of broad white scales on the lateral margin of the scutum just before level of wing base..... (*Stegomyia*) *laffooni*

No area of broad white scales on lateral scutal margin..... (*Stegomyia*) *arboricolus*

57. Scales of *apn* and *ppn* all dark..... (*Stegomyia*) *albolineatus*

At least some of the scales of *ppn* pale, usually some pale scales on *apn* also..... 58

58. Median scutal stripe extending posteriorly to scutellum; *ppn* with narrow-curved creamy scales only..... (*Stegomyia*) *hoogstraali*

Median scutal stripe extending posteriorly only to level of wing bases; *ppn* with narrow dark scales dorsally and broad white scales below..... (*Stegomyia*) *boharti*

59.[9] Hind tarsal segments IV–V all dark. 60

Hind tarsal segments IV–V with white markings (V sometimes all dark in male of *gardnerii*)..... 62

60. Hind tarsal segment III with only a narrow basal white band; proboscis with white markings; (scutum with prominent white scaling; a lower mesepimeral bristle present; hind tarsus with narrow basal bands on I–III)..... (*Christophersiomyia*) *brayi*

Hind tarsal segment III dorsally all white, or nearly so; proboscis dark-scaled..... 61

61. Scutum narrow-scaled, with an obovate antero-median patch of silvery scales; hind tarsal segment II with a broad basal band; paratergite scaled..... (*Stegomyia*) *meronephada*

Scutum covered with plate-like broad dark scales; hind tarsal segment II all dark or with just a very few basal white scales; paratergite bare..... (?) *platylepidus*

62. Hind tarsal segment III all dark, broad basal bands on I–II, IV–V all white (may be some apical black scales on V); (scutum marked with

[8] *Aedes* (*Stegomyia*) sp. near *boharti* is similar to *boharti* except that all three scutellar lobes are covered with broad black scales.

[9] *A. wainwrighti* at present cannot be keyed beyond this point since hind tarsal segments II–V are missing from the single known specimen.

a broad obovate median longitudinal white band that tapers to posterior margin) . . . . . (*Stegomyia*) *mediopunctatus perplexus*

Hind tarsal segments I–V with white markings 63

63. Tibiae ringed with white just before the middle; hind tarsal segments IV–V all white, may be a few apical black scales on IV; (scutum marked with a pair of narrow subdorsal white lines from anterior margin halfway to level of wing bases, a large white patch laterally before wing base, and 3 short longitudinal pale lines between the wing bases) . . . . . (*Stegomyia*) *desmotes*

Tibiae not ringed near the middle; hind tarsal IV with a distinct apical dark band 64

64. Hind tarsal segment V with at least some dark scaling apically, occasionally all dark; the scales along the posterior portion of the scutum all broad; scutum with a pair of broad subdorsal white bands anteriorly and a large white patch before the wing base . . . . . (*Stegomyia*) *gardnerii*

Hind tarsal segment V all white; the scales along the posterior margin of the scutum narrow or mostly so; scutum not marked as above 65

65. Scutum with a pair of thin longitudinal submedian lines and a paired broadened antero-lateral crescent-shaped marking (composed of broad silvery scales); female clypeus with white scaling . . (*Stegomyia*) *aegypti*

Scutum with a narrow tapered median longitudinal band; female clypeus not scaled 66

66. Dorsal abdominal bands basal, detached from the lateral spots; pleural scale patches not forming 2 sharply differentiated longitudinal white bands . . . . . (*Stegomyia*) *albopictus*

Dorsal abdominal bands subbasal on more posterior segments, attached on at least some segments to the lateral spots; pleural scale patches arranged into 2 sharply differentiated longitudinal white bands . . . 67

67. Mid femur anteriorly with a median longitudinal white line, may be poorly developed in female (rarely absent); scutum with a line of white scales on antero-lateral margin . . . . . (*Stegomyia*) *paullusi*

Mid femur without anterior median longitudinal pale markings; scutum without a line of white scales on antero-lateral margin . . . . . (*Stegomyia*) *scutellaris*

Fourth Instar Larval Key

1. Anal plate with an acus (otherwise bare except possibly for spicules on posterior margin) 2

Anal plate without an acus 7

2. Comb of 8–10 teeth in a row . . . . . (*Aedimorphus*) *vexans nocturnus*

Comb of 16 or more scales in a patch . 3

3. Antenna slender, very few fine spicules scattered near base; comb of 40–80 scales 4

Antenna rather stout, large spicules scattered over most of length; comb of 16–28 scales 5

4. Head hair 4 with 13–16 branches; ventral brush with 10 tufts . . . . . (*Finlaya*) *leucopleurus* (in part) . . . . . (*Finlaya*) *aureostriatus* (in part)

Head hair 4 with 4–8 branches; ventral brush with 12 tufts 48

5. Antennal hair with 1–4 branches; ventral brush with 15–17 tufts . . . . . (*Ochlerotatus*) *vigilax ludlowi*

Antennal hair with 5–13 branches; ventral brush with 12 tufts 6

6. Head hair 5 with 6–7 branches; head hair 6 with 4–6 branches; siphon index about 7.0 . . . . . (*Aedimorphus*) *pampangensis*

Head hair 5 with 3–4 branches; head hair 6 with 2–4 branches (usually 3); siphon index 3.5–3.9 . . . . . (*Aedimorphus*) *alboscutellatus*

7. Mouth brushes forming stout, serrate-tipped rods; ventral brush of more than 20 tufts 8

Mouth brushes normal, usually with comb-like tips; ventral brush of no

more than 17 tufts..... 9
8. Ventral brush with 30–32 tufts; pentad hair 2 single....(*Mucidus*) *ferinus*
Ventral brush with 22–26 tufts; pentad hair 2 double.....(*Mucidus*) *aurantius quadripunctis*
9. Comb teeth in a straight or irregular row (3–24 in number)..... 10
Comb teeth in a patch or double row (14–100 in number)..... 34
10. Ventral brush of 8–10 tufts..... 11
Ventral brush of 12–17 tufts..... 24
11. Head hair 5 with 4–20 branches; head hair 12 with 10–25 branches..... 12
Head hair 5 with 1–2 branches; head hair 12 with 2–5 branches..... 18
12. Pecten with 2–6 teeth; antennal hair tuft with 1–5 branches..... 13
Pecten with 12–24 teeth; antennal hair tuft with 5–17 branches..... 15
13. Posterior margin of anal plate with a small area of short spines; stellate hairs of body with 3–6 slender branches.....(*Stegomyia*) *hoogstraali*
Posterior margin of anal plate with a fringe of strong spines; stellate hairs of body with 6–19 stout branches.. 14
14. Ventral brush with all elements borne on the barred area..(*Stegomyia*) *laffooni*
Ventral brush with 2 tufts off the barred area basally.....(*Stegomyia*) *albolineatus*[10]
.....(*Stegomyia*) *boharti*
.....(*Stegomyia*) *arboricolus*
15. Comb teeth fringed to just before apex; ventral brush of 10 tufts....
.....(*Finlaya*) *niveus*
Comb teeth not fringed beyond middle; ventral brush of 8 tufts..... 16
16. Antennal hair tuft with 10–17 branches; spicules on posterior margin of anal plate minute.....(*Finlaya*) *saperoi*
Antennal hair tuft with 5–8 branches; spicules on posterior margin of anal plate stout, long..... 17
17. Head hair 4 with 8–10 branches; 5 with 6–8.....(*Finlaya*) *laoagensis*
Head hair 4 with 13–14 branches; 5 with 9–12.....(*Finlaya*) *albolateralis*
18. Siphon with a distinct, narrowly attached acus.....(*Finlaya*) *harperi*
Siphon without a true acus..... 19
19. Comb teeth borne on a sclerotized plate..... 20
Comb teeth not borne on a sclerotized plate..... 22
20. Barred area of ventral brush not connected laterally; a small patch of spines laterally on the posterior margin of the anal plate.....
....(*Stegomyia*) *mediopunctatus perplexus*
Barred area of ventral brush connected to a prominent sclerotized plate on each side; anal plate smooth..... 21
21. Head hairs 5 and 7 single; ventral brush hairs single..(*Stegomyia*) *desmotes*
Head hair 5 with 3–6 branches; 6 with 3–7 branches; ventral brush hairs double or triple.(*Stegomyia*) *bambusicolus*
22. Meso- and metathoracic pleural spines conspicuous, stout, elongate, and usually curved near apex; comb teeth with prominent lateral spines at the base of the long central spine
.....(*Stegomyia*) *aegypti*
Meso- and metathoracic pleural spines slender, straight, and not conspicuous; comb teeth bearing only a fine fringe at the base of the long spine. 23
23. Ventral brush with 2–3 hairs off the barred area basally; *lh* inserted in a clear area within the anal plate....
.....(*Stegomyia*) *gardnerii*
Ventral brush with all hairs borne within the barred area; no clear area around point of attachment of *lh*
.....(*Stegomyia*) *scutellaris*
.....(*Stegomyia*) *paullusi*
.....(*Stegomyia*) *albopictus*
24. Ventral brush with 14 or more tufts.. 25
Ventral brush with 12 (rarely 11 or 13) tufts..... 27
25. Ventral brush of 16–17 tufts; anal plate complete.(*Banksinella*) *imprimens*

[10]These species have been provisionally separated as follows:
Anal gills finger-like, about twice the length of the anal plate (1.6–2.2).....*albolineatus*
Anal gills tapered from base, about 1.5–1.8 times longer than anal plate.....*boharti*
Anal gills tapered from base, occasionally somewhat lanceolate; dorsal pair 1.05–1.15 times longer than anal plate .....*arboricolus*

Ventral brush of 14–15 tufts; anal plate incomplete 26

26. Head hairs 5 and 6 with 3 (sometimes 2) branches with the median branch stouter and much longer than the lateral branches; antennal spicules darkly pigmented ... (*Aedes*) *nigrotarsis*
Head hair 5 with 1–4 branches; hair 6 single, stout; antennal spicules pale ..... (*Aedes*) *uncus*

27. Head hair 15 developed as a stout, curved, horn-like projection ..... (*Stegomyia*) *meronephada*
Head hair 15 normal, small, usually branched 28

28. Pecten teeth evenly spaced, 20–24 in number ..... (*Finlaya*) *lacteus*
Distal pecten teeth more widely spaced, 5–20 in number 29

29. Ventral brush with 3–5 tufts off the barred area basally; comb teeth with a strong central spine about as long as the base of the teeth; antennal spicules stout, dark ..... (*Banksinella*) *lineatopennis*
Ventral brush with 1–2 tufts off the barred area basally; comb teeth with central spine no more than one-half as long as base of teeth, or with no prominent central spine present; antennal spicules small, pale 30

30. Comb teeth with a complete apical fringe, no prominent terminal spine; pentad hair 2 with 4–6 branches; mentum with 11–13 lateral teeth .. (*Aedes*) *butleri*
Comb teeth with a distinct terminal spine; pentad hair 2 with 1–3 branches 31

31. Mentum with 8–11 lateral teeth; anal gills 1.0–1.5 times as long as anal plate ..... (*Aedes*) *dux*
Mentum with 13 or more lateral teeth; anal gills at least 1.7 times as long as anal plate 32

32. Head hair 5 with 2–3 branches; hair 6 with 2–4 branches .... (*Aedes*) *robertsi* ..... (*Aedes*) *hamistylus*
Head hair 5 with 5–10 branches; hair 6 with 4–8 branches 33

33. Mentum with 18–20 lateral teeth; prothoracic hair 2 single; prothoracic hair 8 double ..... (*Aedes*) *campylostylus*
Mentum with 13–18 lateral teeth; prothoracic hair 2 single or double (usually double); prothoracic hair 8 single or double (usually single) ..... (*Aedes*) *johnsoni* ..... (*Aedes*) *margarsen*

34. Antennal hair with 5–7 branches (rarely 4) 35
Antennal hair with 1–4 branches 36

35. Siphon index 3.4–3.8; pecten teeth with lateral fringe; comb scales with blunt, fringed tips ..... (*Rhinoskusea*) *longirostris*
Siphon index about 2.7; pecten teeth with 2–4 large denticles; comb scales simple, sharply pointed .... (*Cancraëdes*) *curtipes*

36. Ventral brush with 10 tufts (rarely 9 or 11) 37
Ventral brush with 12 tufts (rarely 11 or 13) 46

37. Anal plate bare, or with a few small spicules 38
Anal plate with long spines or scales on posterior margin 40

38. Pecten with 23–26 close-set teeth with basal denticles ..... (*Finlaya*) *leucopleurus* (in part) ..... (*Finlaya*) *aureostriatus* (in part)
Pecten with 7–17 teeth; each with fringe along entire ventral margin . 39

39. Head hair 4 with 6–10 branches ..... (*Skusea*) *amesii*
Head hair 4 with 13–20 branches .... (*Skusea*) *fumidus*

40. Pecten with 18–29 teeth ..... (*Finlaya*) *melanopterus*
Pecten with 4–13 teeth 41

41. Preclypeal spine with at least 2 branches (rarely single in *poicilius*); prothoracic hair 0 large, stellate, with at least 9 branches; margin of anal plate ventral to *lh* with large spines 42
Preclypeal spine single; prothoracic hair 0 small, with not more than 5 branches; no spines ventral to *lh* on margin of anal plate 44

42. Mandible with a large dark tooth anterior to the longest tooth; scales in distal row of comb patch without a pair of distinct lateral denticles near base; (hair 11 of meso- and metathoracic pleural groups short, weak, with 2–4 branches).... (*Finlaya*) *stonei*
Mandible without a large dark tooth anterior to the longest tooth; scales in distal row of comb patch with a paired baso-lateral denticle..... 43

43. Preclypeal spine with 3–6 branches; head hair 4 candelabra-like (rarely fan-like), with 11 or more branches; hair 11 of meso- and metathoracic pleural groups prominently stellate, with many branches.. (*Finlaya*) *ananae*
Preclypeal spine double (rarely single); head hair 4 with 3–7 branches; hair 11 of meso- and metathoracic pleural groups single, stoutly spinose, short..... (*Finlaya*) *poicilius*

44. Hair 11 of meso- and metathoracic pleural groups single, fairly long, stout, spinose; head hair 7 with 2–3 branches..... (*Finlaya*) *luteus*
..... (*Finlaya*) *croceus*
Hair 11 of meso- and metathoracic pleural groups very short, slender, single or double, not spinose; head hair 7 with 4–7 branches..... 45

45. Siphon and anal plate very dark brown
..... (*Finlaya*) *flavipennis*
Siphon and anal plate pale yellow...
..... (*Finlaya*) *medleri*

46. No stellate hairs present; body integument not pilose..... 47
Stellate hairs developed to various degrees; integument slightly to densely pilose..... 49

47. Head hair 5 with 7–12 branches; posterior margin of anal plate with a patch of strong spines. (*Finlaya*) *banksi*
Head hair 5 with 1–2 branches; posterior margin of anal plate with very short or fine spicules only..... 48

48. Lateral hairs on abdominal segments I and II double, stout, darkly pigmented; fringe on apical margin of some comb scales with central element enlarged.. (*Finlaya*) *paradissimilis*
Lateral hairs on abdominal segments I and II with 3–4 branches, moderately stout, brown in color; apical fringe on comb scales even.....
..... (*Finlaya*) *luzonensis*

49. The apical 2–5 pecten teeth ventrally out of line with the others.....
..... (*Finlaya*) *abadsantosi*
..... (*Finlaya*) *sherki*
The apical 2–5 pecten teeth not ventrally out of line with the others (may be dorsally out of line in *burgosi*)..... 50

50. Metathoracic hair 7 with 7–9 branches, normal, slender, elongate; *lh* with 2 or more branches.....
..... (*Finlaya*) *burgosi*
Metathoracic hair 7 with 3–5 branches, relatively short, stout, stellate-like, barbed; *lh* single..... 51

51. No simple (without denticles) pecten teeth apically and no teeth distad of the siphon hair tuft base.....
..... (*Finlaya*) *jugraensis*
Two to 4 simple teeth beyond the base of the siphon hair tuft and usually 1–3 simple teeth basad of the hair tuft..... 52

52. Mesothoracic hair 1 with 1–4 branches; metathoracic hair 1 with 1–5 branches..... (*Finlaya*) *saxicola*
Mesothoracic hair 1 with 8–9 branches; metathoracic hair 1 with 11–14 branches.... (*Finlaya*) sp. near *saxicola*

SYSTEMATICS

Genus *AEDES* Meigen

1818. *Aedes* Meigen, Syst. Beschr. 1: 13. Genotype: *cinereus* Meigen.

ADULT: Distinct from all the other Philippine genera of the tribe Culicini, except *Mansonia* (*Mansonioides*) and *Armigeres* (*Armigeres*), by the possession of postspiracular bristles. From the former, *Aedes* is distinct in lacking specialized teeth on the female eighth tergite and in not having asymmetrical broad wing scales. From the latter, the genus *Aedes* is distinct with certainty only in the larval

stage, i.e., by the presence of a pecten on the siphon. However, the general habitus of the *Armigeres* adult is relatively distinct, and the proboscis is generally stouter and more conspicuously recurved. Other important characters of the genus *Aedes* are: Prescutellar bristles present (not in *platylepidus*). *Apn* lobes widely separated. Postnotum without setae. Spiracular bristles absent. Upper margin of meron above level of base of hind coxa. Pulvilli absent, or hair-like. Squama with a fringe of bristles (more than four). Wing with distinct microtrichia. Vein 6 reaching beyond base of fork of vein 5.

LARVA: Not distinct from that of *Heizmannia*, but distinguished from the other genera in the Philippines by the combination of the following characters: Siphon with a pecten and with only a single pair of ventral hair tufts, and ventral brush of eighth segment including at least four hairs.

DISTRIBUTION: Worldwide. Of the 23 recognized aedine subgenera, 12 are known to occur in the Philippines. The following subgenera have not yet been found there: *Chaetocruiomyia*, *Diceromyia*, *Dunnius*, *Howardina*, *Indusius*, *Leptosomatomyia*, *Levua*, *Macleaya*, *Pseudoskusea*, *Kompia*, and *Soperia*.

Faunistically the Philippine Islands are a part of the Oriental Region. This is well illustrated in the genus *Aedes*. Of the 74 known Philippine species, only 11 also occur in the Australasian Region, 2 in the Ethiopian Region, and 1 in the Palaearctic Region. Within the Oriental Region the Philippine *Aedes* fauna is an intimate part of the Malayan Subregion. However, as would be expected from the isolated position of the Philippines, the *Aedes* fauna there is particularly rich in endemic forms, 46 species at present being in this category.

Subgenus MUCIDUS Theobald

1901. *Mucidus* Theobald, Mon. Cul. 1: 268. Genotype: *alternans* Westwood (Australia).

ADULT: Distinguished from all the other subgenera in the Philippines by either of the following: Wing membrane surrounding crossveins 2–3, 3–4, and 4–5 clouded, these three approximated; *ppn* with 10–30 bristles. Other characters: Palpi of male as long as or longer than proboscis. Vertex dorsum and scutellum narrow-scaled. Paratergite scaled. Lower mesepimeral bristles present. Fore and mid tarsal claws of male unequal, larger claw bidentate or unidentate, smaller unidentate; hind claws equal, simple or unidentate; of female equal, each unidentate. *Terminalia:* Basistyle with a weakly developed basal lobe, but without an apical lobe. Mesosome simple. Claspettes present.

LARVA: Distinguished from all the other subgenera in the Philippines by any of the following: Mouth parts modified for predacity, the mouth brushes forming matted tufts of serrate-tipped rods and the mandibular teeth very large and strong; head hair 4 considerably external to hairs 5 and 6; ventral brush extending the complete length of the anal segment. Habitat—temporary ground pools.

DISTRIBUTION: The 13 known species and subspecies are confined to the tropics of the Ethiopian, Oriental, and Australasian Regions. Two species and one subspecies are known from the Philippines.

SYSTEMATICS: The subgenus has been divided by Edwards (1932) into two groups: Group A (*Mucidus*) and Group B (*Pardomyia*) (see adult species key for separation points). Group A is represented in the Philippines by *ferinus* Knight and *laniger* (Wiedemann) and Group B by *aurantius quadripunctis* (Ludlow).

Aedes (Mucidus) ferinus Knight

1947. *Aedes* (*Mucidus*) *ferinus* Knight, Jour. Wash. Acad. Sci. 37: 316 (males, females, pupae, larvae). Type locality: Philippines. San Ramon (Penal Farm), City of Zamboanga Prov., Mindanao (Laffoon and Knight). Type: Male (holotype), with

associated larval and pupal skins, in U. S. N. M.†

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Luzon: Olongapo, Subic Bay, Zambales Prov. Mindanao: San Ramon (Penal Farm) and Zamboanga, City of Zamboanga Prov. A.N.S.P. Leyte: Dulag. C.C. (1 female). Luzon: San Miquel, Tarlac Prov. (Franclemont).

Unknown outside the Philippines.

DISCUSSION: In addition to being closely related to *laniger* (Wied.), this species is also similar to *scatophagoides* (Theo.), from which it differs in tarsal markings and male genitalia (Knight, 1947*a*: 319). The pupal abdomen has been figured by Knight and Chamberlain (1948: fig. 25).

Aedes (Mucidus) laniger (Wiedemann)

1821. *Culex laniger* Wiedemann, Dipt. Exot., p. 9 (female). Type locality: Java. Type: In Copenhagen Museum.

1901. *Mucidus laniger* Wiedemann. Theobald, Mon. Cul. 1: 269. Different combination.

1906. *Mucidus mucidus* Karsch. Banks, Phil. Jour. Sci. 1: 983. Misidentification.

1908. *Mucidus mucidus* Theobald. Leicester, Cul. Malaya, p. 69. Error in author assoc., and misidentification.

Adult partially described by Barraud (1934: 147) and Knight (1947*a*: 320). The latter paper also discusses the systematics of this species. The larva is undescribed.

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Mindanao: Ludlow Barracks, Parang. Pettit Barracks, Zamboanga, City of Zamboanga Prov.

Literature records. Mindoro: Calapan (Edwards, 1929: 5). Luzon: Manila, Manila Prov. (Banks, 1906: 983). This record is to be questioned since the species was merely listed as *Mucidus mucidus* Karsch and thus could equally well be *ferinus*.

Known also from Sumatra, Celebes, Java, Malaya, Indo-China, Ceylon, and (?) Assam.

DISCUSSION: Because of the incompleteness of Wiedemann's description and because of the discrepancies existing between it and the specimens assigned to this species by various authors, the exact identity of *laniger* will remain doubtful until either the types, or specimens from the type area, are studied. It is quite possible that, when more material is available from the Philippines, *ferinus* and the above-mentioned Philippine specimens of *laniger* will prove to be one and the same species. Whether or not the Philippine material will then prove to be specifically different from that of the Netherlands East Indies remains to be seen.

Aedes (Mucidus) aurantius quadripunctis (Ludlow)

1910. *Pardomyia quadripunctis* Ludlow, in Theobald, Mon. Cul. 5: 608 (female). Type locality: Philippines. Parang, Mindanao (Page). Type: Female (holotype), in U. S. N. M.†

1932. *A.* (*M.*) *aurantius* var. *quadripunctis* Ludlow. Edwards, Genera Insectorum, fasc. 194: 135. Different combination.

1945. *Aedes* (*Mucidus*) *quadripunctis* (Ludlow). Bohart, Syn. Phil. Mosq., p. 55. Different combination.

Adult and larva have been fully described by Knight (1947*a*: 322).

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Mindanao: Type female, Parang. A.N.S.P. Leyte: Tacloban. Dulag.

Unknown outside the Philippines.

DISCUSSION: In a previous treatment (Knight, 1947*a*), the senior author followed Bohart (1945: 55) in considering *quadripunctis* a full species. However, in view of the obviously close relationship of this form to *aurantius* and its subspecies, we have here considered it a subspecies (following Edwards, 1932: 135, except that he classed *quadripunctis* as a variety). From the little that we know at present of the *aurantius* complex it would appear that the subspecies are truly geographic in nature, as follows: *a. quadripunctis*

from the Philippines; *a. aurantius* (Theobald) from Malaya, Borneo, Sumatra, and New Guinea; *a. chrysogaster* (Taylor) from Queensland; and *a. painei* Knight (formerly *a. nigrescens*) from the Solomons.

This subspecies is primarily distinct from the other members of the *aurantius* complex on the color of the scutal scaling.

Subgenus OCHLEROTATUS Lynch Arribalzaga

1891. *Ochlerotatus* Lynch Arribalzaga, Rev. Mus. La Plata 2: 143. Genotype: *confirmatus* L. A. (syn. of *scapularis* Rondani) (South America).

ADULT: Distinguished from all the other subgenera in the Philippines by a combination of the following: Male palpi as long as the proboscis, mesosome simple, claspettes present and with filament setiform, and basistyle with a distinct basal lobe. Other characters are: Male palpi approximately equal to the proboscis in length; segment III with apex upturned, IV and V declined; the apex of III and all of IV and V with a dense band of long, laterally and ventrally directed hairs. Vertex dorsum and scutellum narrow-scaled. Acrostichal and dorso-central bristles present. Paratergite usually with sparse scaling. Lower mesepimeral bristles absent. Fore and mid tarsal claws of male unequal, larger claw bidentate (mid of *vigilax ludlowi* has median tooth reduced to a swollen area), smaller unidentate; of female equal and unidentate; hind claws simple in both sexes. *Terminalia:* Basistyle with a distinct basal lobe. Dististyle appendage apical. Mesosome simple. Claspettes present, with distinct spine- or bristle-like filament.

LARVA: Separable from all the other subgenera in the Philippines, except *Aedimorphus* and some specimens of the *Finlaya* species *leucopleurus* and *aureostriatus*, by the possession of an acus on the anal plate. Antennal hair tuft with 1–4 branches. Head hair 4 with 4–5 branches, 5 and 6 single. Comb with 23–28 scales in a patch. Siphon with an attached acus; 5–12 pecten teeth, evenly arranged. Anal plate incomplete. Ventral brush with 15–17 tufts, all but the basal two arising from a laterally connected barred area. Habitat—temporary, brackish ground pools.

DISTRIBUTION: This is a very large subgenus with many species in all the regions of the world except the Ethiopian and Oriental, where it is represented by only a few species. The single form found in the Philippines is a subspecies of a species common throughout the Australasian Region.

SYSTEMATICS: Edwards (1932: 136) divided the subgenus into eight groups, with the single Philippine species falling into Group A (*taeniorhynchus*-group: *Culicelsa*). This group is distinguished by the absence of a definite apical lobe on the basistyle, and in having the claspette filament bristle-like.

Aedes (Ochlerotatus) vigilax ludlowi (Blanchard)

Figs. 2, 3

1903. *Culex annulifera* Ludlow (nec E. Blanchard, 1852), Jour. N. Y. Ent. Soc. 11: 141 (females). Type locality: Philippines. Mangarin, Mindoro (Suggs). Type: Female lectotype here designated from a series of nine female cotypes in the U. S. N. M.† One female cotype also exists in the British Museum.

1904. *Culex annuliferus* Ludlow. Ludlow, Can. Ent. 36: 72. Emendation.

1905. *C. Ludlowi* R. Blanchard, Les Moust., p. 630. Nom. nov.

1917. *Ochlerotatus annuliferus* (Ludlow). Edwards, Bul. Ent. Res. 7: 215. Different combination.

1922. *Aëdes* (*Ochlerotatus*) *vigilax* (Skuse). In part. Edwards, Bul. Ent. Res. 13: 99. Synonymized *ludlowi*.

1925. *Culex ludlowi* Theobald. Dyar and Shannon, Ins. Insc. Mens. 13: 76. Error in author association.

1929. *annulipes* Ludl. Edwards, Notulae Ent. 9: 2. In error for *annulifera* when quoted as a synonym of *vigilax*.

ADULT: A medium-sized brown species with pale markings on the proboscis, scutal scales brown (female) or brownish-golden (male), abdominal tergites possessing straight basal white bands, and all the hind tarsal segments marked by basal white bands.

Male. Length of wing 3.0–3.5 mm. *Head:* Proboscis dark, marked with a pale-scaled area beginning at basal one-third on the ventral and lateral aspects and extending to just beyond the middle, the medial portion of this band extending onto the dorsum and forming a complete band. Palpus approximately equal to proboscis in length, with basal white rings on the last three segments. Torus bare. Vertex dorsally with pale narrow scales and pale and dark upright-forked scales (the pale uprights being medial and the dark ones lateral); laterally with a patch of broad creamy scales. *Thorax:* Scutum clothed with small narrow brownish-golden scales; the scales on the prescutellar area and on the scutellum narrow and pale yellow. *Apn* with narrow-curved pale yellowish scales, sometimes a few broadened scales also apparent; *ppn* rather thinly covered with mixed narrow and broad dark scales (the broad scales being mostly ventral), in addition there are a few narrow yellow scales present dorsally and a few broad pale scales ventro-posteriorly. Following pleural areas each with a small patch of broad cream-colored scales: propleural, paratergite (very few and frequently none), postspiracular, prealar (below the knob), upper sternopleural, medio-posterior sternopleural, and upper mesepimeral (this patch begins on the anterior border adjacent to the upper sternopleural patch; in addition there is a more or less detached group of mixed broad and narrow pale scales associated with the hair tuft). No lower mesepimeral bristles. *Legs:* Femora dark-scaled, anteriorly marked with scattered pale scaling, posteriorly partially pale-scaled (the hind femur extensively so). Tibiae dark, fore and mid with posterior pale scaling. Fore and mid tarsi with narrow basal white bands on I–III; hind tarsus with basal white bands on all segments, broad on II–V. Fore tarsal claws unequal, the larger claw bidentate, the smaller unidentate; mid tarsal claws unequal, the larger claw with a basal tooth and a swollen area medially, the smaller unidentate; hind tarsal claws equal, simple. *Wing:* Dark-scaled. *Abdomen:* Tergite I with a lateral patch of creamy scales, II–VII with straight basal creamy white bands. Sternites pale-scaled with apical dark-scaled bands. *Terminalia:* Basistyle with a prominent, densely setose basal lobe; two rather stout bristles subapically on the inner tergal margin. Dististyle appendage apical. Claspette filament spine-like. Ninth tergite lobes each bearing 3–4 bristles.

FIG. 2. *A.* (*Ochlerotatus*) *vigilax ludlowi.* Male terminalia (Luzon).

Female. Length of wing approximately 3.2–3.5 mm. Proboscis dark with creamy scaling laterally and ventrally from level of palpal apex to just beyond middle, the pale-scaled area sharply delimited apically; pale scaling may extend onto dorsal surface. Palpus approximately one-sixth the length of the proboscis; dark with apex narrowly white-scaled. Torus bare or with a few dark hairs. Vertex with upright-forked scales all dark; the lateral patch of broad creamy scales with a

median band of broad black scales. Scutal scales more brownish than in male, indefinite light and dark areas usually apparent; prescutellar, supra-alar, and scutellar bristles dusky. *Ppn* densely covered with narrow and narrow-curved dark scales, a few broad dark and pale scales may be present ventrally and posteriorly. Pleural scale patches more strongly developed than in male, always a few scales on paratergite. Fore and mid femora more extensively pale-scaled posteriorly than in male. Tarsal claws equal, fore and mid claws each unidentate, hind claw simple. Wing with or without a basal posterior line of pale scales on the costa, may also be a few pale scales basally on vein 1 and scattered elsewhere. Tergite I with a few baso-median pale scales and a lateral white band; V–VII (sometimes only VI–VII) with narrow creamy apical bands; sub-basal lateral creamy spots present on II–VI. Sternites VI–VII with a pale apical band; on II–VI the pale-scaled area medially may extend to the posterior margin.

LARVA: *Head:* Antenna sparsely spiculate; antennal hair with 1–4 branches, inserted medially. Mouth brush with comb-like tips. Preclypeal spines stout, curved, darkened. Hair 4 minute, with about 4–5 branches; 5 and 6 single, well-produced; 7 with 7–10 branches; 8 and 9 with 2–3; 12 with 3–5; 13 single; 14 with 1–2; 15 with 2–4; 17 single; 18 with 1–2; 20 with 3–4. Mentum with 8–10 teeth. *Abdomen:* Dorso-lateral hairs on I and II with 3–4 branches. Lateral hairs on I to VI double or triple. Pentad hair 1 with 2–4 branches; 3 with 9–15; 5 with 4–6. Comb with 23–28 small acutely tapered scales in a patch, each with a lateral fringe from base to apex. Siphon pale, short and broad, acus present; 5–12 pecten teeth, each with several basal denticles; siphon hair tuft inserted medially and just before apex of last pecten tooth, with 10–13 faintly plumose branches. Anal plate narrowly incomplete, some small denticles present dorsally on the posterior margin; *lh* single; *isc* with 9–11 branches; ventral brush extends nearly the whole length of the anal plate, of 15–17 tufts, each with 4–12 branches, all but the basal two arising from a connected barred area. Anal gills very short, tapered from near base to a round apex; dorsal pair approximately one-half as long as the anal plate and slightly longer than the ventral pair.

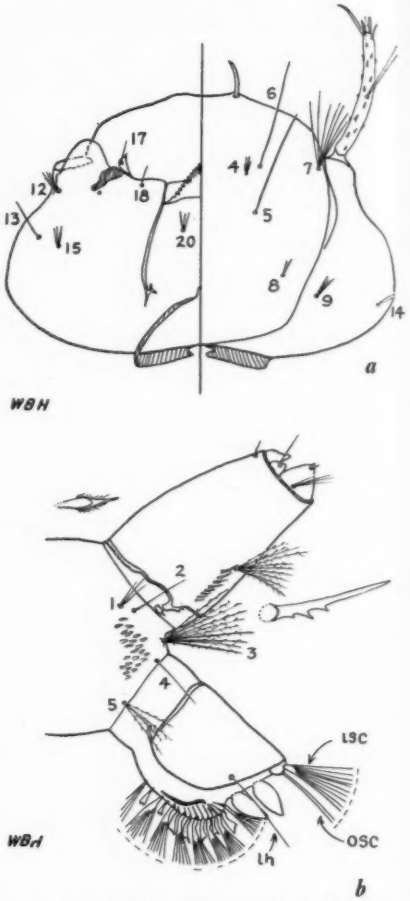

FIG. 3. *A. (Ochlerotatus) vigilax ludlowi.* Larva (Mindoro). *a*, Head; *b*, terminal segments.

BIONOMICS: The only information found in the literature for the adult of this subspecies is a note by Ludlow (1905:135) stating that adults were "caught in woods." The single female cotype specimen in the British Museum is labeled from "mangroves."

Judging from the fact that 6 months extensive collecting in the Philippines produced only two collections of *vigilax ludlowi* (both larval), this subspecies is apparently rather uncommon. Both of these collections were taken from small temporary ground pools surrounding rice paddies. The pools were recorded as being open to the sun, containing many algae, and possessing water rusty in appearance. Unfortunately no record was made as to whether or not the water of the pools was brackish in nature. However, Dr. E. S. Ross collected this species on Mindoro from shaded, temporary brackish pools at the edge of salt marsh. Penn (1948: 245) reported a larval collection taken on Mindoro from a sunlit fresh-water pool with a *p*H of 6.0.

Aedes vigilax vigilax (Skuse), which is a widespread coastal species in the Australasian and Oriental Regions (but not reported from the Philippines), is a brackish-water breeder of great economic significance. After periods of unusually high tides the larvae occur in tremendous numbers in brackish pools along the seacoast just above the normal high-tide level. The adults soon emerge in great swarms, and since they are vicious and persistent day and night biters, they quickly succeed in seriously impeding all outdoor human activities in the surrounding area. As with the salt marsh mosquitoes of the United States, the adults of *v. vigilax* will travel or drift considerable distances inland. Hill (1925: 71) reported that *v. vigilax* can occasionally be found in fresh water, and that larvae from such breeding sites possess longer and narrower anal gills than those from brackish water.

DISTRIBUTION: *Specimens examined.* U.S.-N.M. (5 males, 11 females, 2 sets assoc. skins). Luzon: Olongapo, Subic Bay, Zambales Prov. (Zolik and MacMillan). Mindoro: Type females, Mangarin. C.A.S. (2 males, 2 females, 2 larvae, 1 set assoc. skins). Mindoro: Nr. mouth of Labangan River (Ross).

Literature records. Mindanao, Panay, Mindoro, Luzon (all Bohart, 1945: 56). Luzon: Manila (Edwards, 1929*a*: 2). Mindoro: Caminawit Pt. (Penn, 1948: 245).

Not known from outside the Philippines.

DISCUSSION: The Philippine form is treated here as a distinct subspecies of *vigilax* (Skuse) on the basis of the scaling of *ppn* in the female. In *v. vigilax* this area is covered with flat-lying slightly elongate broad scales, except for a fringe of narrow dark scales dorsally. The broad scales are dark except for a small ventral posterior patch of pale ones. The type of *v. vigilax* has not been seen by us, but the types of the synonyms *uniformis* Strickland (female) and *marinus* (Theobald) (male, female), which are in the British Museum, have been. In addition, a series of Australian specimens in the British Museum and two females from the New Hebrides which are in the U. S. National Museum have been studied. In all these specimens of *v. vigilax*, *ppn* was found to be scaled as described above. No other differences have been found, although Philippine specimens have been compared with males, pupae, and larvae of the New Hebrides series.

A. vigilax vigilax and *v. ludlowi* are commonly confused with *Aedes* (*Aedimorphus*) *vexans*, from which species they can readily be distinguished by their lack of scales on the torus and on the subspiracular area.

Subgenus FINLAYA Theobald

1903. *Finlaya* Theobald, Mon. Cul. 3: 281. Genotype: *poicilia* Theobald (Malaya).

1905. *Popea* Ludlow, Can. Ent. 37: 95. Genotype: *lutea* Ludlow (Philippines).

ADULT: Essentially similar to *Ochlerotatus* but differing in the absence of a distinct basal lobe on the basistyle in most species. Those few species that possess a distinct basal lobe differ from the single Philippine species of *Ochlerotatus* in not having the claspette filament setiform. Male palpi varying from being three-fourths as long as pro-

boscis to exceeding it by the length of the terminal segment; usually similar to *Ochlerotatus* in type but may be simple, straight, and with only a few hairs (at apices of segments III–V). Vertex dorsum and scutellum narrow- or broad-scaled, or with intermediate conditions occurring. Paratergite with or without scales. No lower mesepimeral bristles. Fore and mid tarsal claws toothed in both sexes, in the male the larger claws usually bidentate; hind claws simple in both sexes. *Terminalia:* Basistyle with apical lobe absent; basal lobe usually absent but occasionally weakly formed, or rarely even distinct (*harperi*). Dististyle appendage apical. Mesosome simple. Claspettes present (with a peculiar basotergal lobe in *aureostriatus*), with a prominent, variously shaped filament.

LARVA: Extremely varied, but having in common the following few characteristics: Siphon almost always with an acus at level of pecten teeth. Anal plate without acus, always incomplete, nearly always with spines or spicules on posterior lateral margin. Ventral brush with 8–12 tufts, usually borne on a sclerotized, barred area. Habitat primarily of three types: (1) the water-holding spaces of living plants, (2) tree holes and bamboo stumps, and (3) rock holes in stream beds. One species breeds in the water collected in fallen leaves. A number of species have been occasionally found in artificial containers.

DISTRIBUTION: This is a very large subgenus with approximately 165 named species and subspecies and having a worldwide distribution (absent from the northern rim of the Holarctic Region, however). The subgenus has attained its greatest development in the Oriental Region. Twenty-five named species are at present known from the Philippines.

SYSTEMATICS: On the basis of adult ornamentation characters, this subgenus was divided into eight groups by Edwards (1932: 148). Knight and Marks (in press) modified this system by combining two of the groups and by creating subgroups. Except for Group C, which is confined to the Ethiopian Region, all the groups are represented in the Philippines.

Group A (*kochi*-group). Wings profusely spotted with areas of pale and dark scaling. Represented in the Philippines by *ananae*, *poicilius*, *stonei*, *medleri*, *croceus*, *flavipennis*, and *luteus*.

Group B (*terrens*-group). Hind tarsi with basal and apical white bands on I, a narrow basal band on II, remainder dark. Represented in the Philippines by *melanopterus*.

Group D (*aureostriatus*-group). Scutal marking pattern consisting of 3–5 narrow longitudinal pale lines. Femora and tibiae not lined anteriorly for nearly their whole length. Represented in the Philippines by *aureostriatus*, *saxicola*, *abadsantosi*, *burgosi*, *rizali*, *sherki*, and *jugraensis*.

Group E (*mediovittatus*-group). Similar to Group D except that at least the mid femora and usually also one or more of the tibiae are lined anteriorly with pale scales for nearly their whole length. Represented in the Philippines by *banksi*.

Group F (*alboannulatus*-group). Scutal pale scale pattern not consisting of a set of longitudinal lines. Hind tarsi with basal bands on at least the first three segments. Represented in the Philippines by *harperi*.

Group H (*geniculatus*-group). Tarsi all dark. Represented in the Philippines by *saperoi*, *lacteus*, *laoagensis*, *niveus*, *paradissimilis*, *leucopleurus*, *luzonensis*, and *leucomeres*.

Aedes (Finlaya) ananae Knight and Laffoon
Fig. 4

1946. *Aedes* (*Finlaya*) *ananae* Knight and Laffoon, Trans. Amer. Ent. Soc. 72: 218 (males, females, pupae, larvae). Type locality: Philippines. Osmena, Basey Municipality, Samar (Laffoon). Type: Male (holotype), with associated larval and pupal skins, in U.S.N.M.†

1947. *Aedes* (*Finlaya*) sp. near *poicilius*. Marks, Univ. of Queensland Dept. Biol. Papers 2(5): 34.

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Samar: Osmena, Ducong, and Pintanahon, Basey Municipality. Mindanao: 1 male, 2 females, 2 sets of assoc. skins, Lanao, nr. Cotabato-Lanao provincial boundary along the Parang-Malabang Highway, Lanao Prov. (Enke, Hoogstraal). A.N.S.P. Leyte: Lagolago, nr. Baybay; Mt. Lobi, Dagami; Tacloban.

Literature records. Luzon: Lucban, Tayabas Prov. (Marks, 1947: 34).

Unknown outside the Philippines.

DISCUSSION: The only closely related species in the Philippines is *poicilius* (Theobald) which, however, is distinguishable from *ananae* on the basis of the adult and larval characters given in the keys.

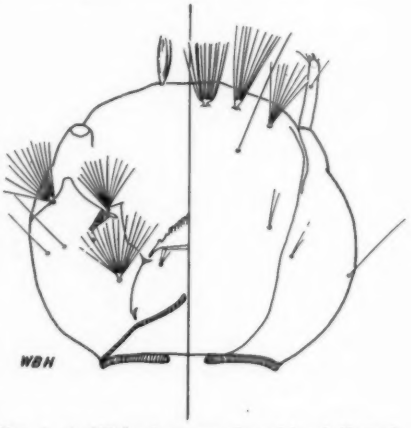

FIG. 4. *A.* (*Finlaya*) *ananae.* Larval head (Samar).

Aedes (Finlaya) poicilius (Theobald)

1903. *Finlaya poicilia* Theobald, Mon. Cul. 3: 283 (female). Type locality: Malay Peninsula. Pulau Jerezak, Penang (Freer). Type: Female (holotype) in B. M.†

1903. *Finlaya poicilipes* Theobald, Mon. Cul. xvii, plate 13. Lapsus.

1904. *Finlaya poialia* Theob. Giles, Jour. Trop. Med. 7: 366. Emendation?

1917. *Aëdes* (*Ochlerotatus*) *poicilia* Theob. Edwards, Bul. Ent. Res. 7: 211. Different combination.

1920. *Aedes* (*Finlaya*) *poicilia* Theobald. Dyar, Ins. Insc. Mens. 8: 183. Different combination.

1926. *Aedes* (*Finlaya*) *kochi* var. *poicilia* (Theo.). Edwards, Bul. Ent. Res. 17: 104. Different combination.

1929. *Aëdes* (*Finlaya*) *poecilia* Theo. Edwards, Not. Ent. 9: 2. Emendation?

1934. *Aëdes* (*Finlaya*) *poecilus* Theobald. Barraud, Fauna Brit. Ind. Dipt. 5: 157. Emendation.

1937. *Aedes* (*Finlaya*) *poicilius.* Bonne-Wepster and Brug, Geneesk. Tijdschr. Ned.-Ind. 74: 44. Emendation.

1944. *Aedes poecilius* (Theobald). Stone and Bohart, Proc. Ent. Soc. Wash. 46: 211. Lapsus in synonymic table.

Adult and larva described by Barraud (1934: 157), Marks (1947:34), and Knight and Laffoon (1946: 221). Stone and Bohart (1944: 211) have keyed the adult and figured the male terminalia, and Brug (1931: 22) and Bonne-Wepster and Brug (1939: 1246) have described the larva.

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Luzon: Olongapo, Subic Bay, Zambales Prov.; Los Banos, Laguna Prov.; Camp Stotsenberg and Mabalacat, Pampanga Prov.; Ft. Wm. McKinley, Rizal Prov.; Manila, Manila Prov.; Camp Daraga, Albray Prov.; Nagillian. Leyte: Gabas, Tacloban; Abuyog. Samar: Osmena; Pintanahon; Ducong; Calotans; Catubig. Jinamoc Island. Calicoan Island. Palawan: Iwahig; Balsahan River; Puerto Princesa. Culion: Pilapil. Balabac: Cape Melville. Mindanao: Zamboanga, Pasanonco, and San Ramon, City of Zamboanga Prov.; Parang, Surigao Prov.; Rugagus, Dansalan, Dansalan City Prov. (Enke, Gutierrez). Nanka, Mumungan, Lanao Prov. (Edgar, Enke). Overton, Lanao Prov. (Enke, Gutierrez, Corcega). A.N.S.P. Leyte: Tacloban; Lagolago (nr. Baybay); Palo; Dulag; Valencia. Dinagat: Panamaon. C.A.S. Mindoro: 5 females, with assoc. skins, San Jose (Ross). Leyte: 1 male, Tunga (Ross). C.C.

Luzon: Agoo, La Union Prov. (Franclemont).

Literature records. Negros: Bago and Mailum, Negros Occidental Prov. (Banks, 1906: 990). Luzon: Lucban, Tayabas Prov. (Marks, 1947: 34).

Known outside of the Philippines from Simaloer, Lombok, Java, Sumatra, Borneo, Celebes, Malaya, North Bengal, and Burma.

DISCUSSION: The type of *poicilius* has been examined and found to differ most notably from the Philippine material described here in lacking the basal spot of white scales on the first segment of the fore tarsus (a clear bare spot is present, however). Because of this difference, although admittedly minor in nature, it seems possible that the Philippine material may represent a distinct form. If it does, then it is not confined to the Philippines because in checking for the presence or absence of basal pale scales on I of the fore tarsus on all the female specimens in the British Museum collection it was found that the specimens (three in all) from Lampongs, Sumatra (Shüffner); Batavia, Java (Brug); and Buitenzorg, Java (Paine), all possessed the basal spot of white scales. On the other hand, the specimens (five in all) from Kuala Lumpur, Malaya (Dusham); Kuching (?), Sarawak, Borneo (Moulton); Mt. Korinchi, Sumatra (Robinson and Kloss); and Sandoway, Burma (Barraud), were all similar to the type in lacking the spot.

The type and the specimens from Kuala Lumpur and Kuching also differed from the Philippine specimens in having the lateral scutellar lobes entirely black-scaled except for 2–3 white scales mesally. The specimens from Mt. Korinchi and Buitenzorg had the lateral lobes white-scaled (white basally and dark apically in the Philippine material). However, since the relative amounts of dark and pale scaling of the lateral scutellar lobes are normally somewhat variable in Philippine specimens, this character is probably not of value.

In view of the above-described variations, it would be of great interest to compare the male terminalia of specimens from various portions of the geographical range of *poicilius*. Unfortunately there are no male specimens in either the British Museum or the U. S. National Museum from any locality outside the Philippines. Brug (1934: 513) figured the terminalia from unspecified material (undoubtedly from the Netherlands East Indies, however), but, since he did not include the tergal setal pattern of the basistyle, it is impossible to make a complete comparison with Philippine specimens. However, in the details shown there are no apparent differences.

The only larval descriptions of specimens from elsewhere than the Philippines (and where the collection locality is definitely given) are by Brug (1931: 22, from Javan specimens) and by Edwards (in Barraud, 1934: 158, from Brug's Javan material). Brug described the larva as having head hair 5 with 3 branches and as having a stout elongate spine at the base of the thoracic pleural tufts. Edwards' description differs from that of Brug's in stating that no special spines occur on the plates of the thorax (describes head hair 5 as having 2–3 branches). Whether or not the thoracic spines occur, the Javan specimens are markedly distinct from those of the Philippines on the branching of head hair 5. Three larval specimens in the British Museum from Klakali, R. Bedali, East Java (Thieneman, reared ex *Colocasia*), have been compared (presumably the ones referred to by Edwards in Barraud, 1934) with Philippine specimens. The only notable differences found were: antennal hair double in four of six cases (remainder single), hair 1 (preclypeal spine) single, and head hair 5 with 2–4 branches. Hair 11 of the meso- and metathoracic segments was stoutly spinose as Brug pointed out and as is typical of the Philippine specimens.

Aedes (Finlaya) stonei Knight and Laffoon

1946. *Aedes (Finlaya) stonei* Knight and Laffoon, Trans. Amer. Ent. Soc. 72: 208

(males, females, pupae, larvae). Type locality: Philippines. Ducong, Basey River, Basey Municipality, Samar (Zolik). Type: Male (holotype), with associated larval and pupal skins, in U.S.N.M.†

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Samar: Ducong and Osmena, Basey Municipality. A.N.S.P. Leyte: Mt. Lobi, Dagami.

Unknown outside the Philippines.

DISCUSSION: Distinct from all the other black, yellow, and white species of this group in the Philippines on the basis of the adult and larval characters given in the keys.

Aedes (Finlaya) flavipennis (Giles)

1904. *Finlaya flavipennis* Giles, Jour. Trop. Med. 7: 366 (male, female). Type locality: Philippines. Camp Stotsenberg, Pampanga Province, Luzon (Whitmore). Type: Male and female (cotypes) in B. M.† Male terminalia mounted.

1906. *Finlaya aranetana* Banks, Phil. Jour. Sci. 1: 1001 (male, female). Type locality: Philippines. Mailum, Bago Municipality, and Siya-Siya Peak, Canloan Volcano, 700 m., Negros Occidental Province, Negros (Banks). Type: Male (lectotype) in U. S.-N. M.†

1917. *Aedes* (*Ochlerotatus*) *flavipennis* Giles. Edwards, Bul. Ent. Res. 7: 211. Different combination.

1922. *Aedes* (*Finlaya*) *flavipennis* Giles. Edwards, Ind. Jour. Med. Res. 10: 465. In part. Different combination. Synonymy of *aranetanus*.

1925. *Finlaya aranteana* Banks. Dyar and Shannon, Ins. Insc. Mens. 13: 75. Lapsus.

1944. *Aedes* (*Finlaya*) *aranetanus* (Banks). Stone and Bohart, Proc. Ent. Soc. Wash. 46: 207. Also: Bohart (1945: 56), Knight and Laffoon (1946: 214), Baisas (1946: 30), and Marks (1947: 62). Misidentification.

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Luzon: Ft. McKinley, Rizal Prov.; Camp Stotsenberg, Pampanga Prov.; Baguio, City of Baguio Prov.; Olongapo, Subic Bay, Zambales Prov. Leyte. Samar: Bulusao; Osmena. Calicoan Island. Negros (cotypes). Palawan: Puerto Princesa; Iwahig; Bacungan. Busuanga Island: Coron. Balabac: Cape Melville. A.N.S.P. Leyte: Palo; Tacloban. C.A.S. Mindoro: 2 males, with assoc. skins, San Jose (Ross).

Literature records. Luzon: Llavac, Infanta Municipality, Tayabas Prov.; Calauan, Laguna Prov.; Tungkong Manga, San Jose, Bulacan Prov.; Tala Estate of Caloocan, Manila Prov. (Baisas, 1946: 30).

Not definitely known from outside the Philippines.

DISCUSSION: An examination of the type series of this species in the British Museum and comparison with a female cotype of *aranetana*, also in that collection, show Edwards (1922: 465) to have been correct in reducing the latter species to a synonym of *flavipennis*. The one male and two female cotypes of *aranetana* in the U.S.N.M. have also been checked and with the same results.

Edwards (1926: 105; 1928: 52) reported this species from Singapore, but it seems likely that a re-examination of that material will show it to be another species. As pointed out by Knight and Laffoon (1946: 215), the material identified by Brug (1934: 513; 1939: 107) is undoubtedly some other species also. The nature of the subapical scale tuft of the basistyle and of the stem of the claspette as illustrated by him are quite different from either of those structures in *flavipennis*. The female specimen reported from the Solomon Islands by Paine and Edwards (1929: 315) is undoubtedly *solomonis* Stone and Bohart. This specimen is also the basis of the Solomon Islands' record of *flavipennis* by Knight, Bohart, and Bohart (1944: 52).

Occasionally a female specimen of this species is found which is apparently indistinguishable from either *medleri* or *croceus*.

Aedes (Finlaya) medleri
Knight and Laffoon

1946. *Aedes* (*Finlaya*) *medleri* Knight and Laffoon, Trans. Amer. Ent. Soc. 72: 211 (males, females, pupae, larvae). Type locality: Philippines. Jinamoc Island (Medler). Type: Male (holotype), with associated larval skin, in U.S.N.M.†

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Samar: Pintanahon and Osmena, Basey Municipality. Jinamoc Island. Calicoan Island: Ngolos. Mindanao: Zamboanga, City of Zamboanga Prov. A.N.S.P. Leyte: Tacloban. C.A.S. Mindoro: 1 male, 1 set assoc. skins, San Jose (Ross).

Unknown outside the Philippines.

DISCUSSION: As indicated by the adult and larval keys, this species is closely related to *flavipennis*, differing from it only on minor characters. Since the ranges of the two overlap, it is likely that *medleri* is merely a polymorphic form of *flavipennis*.

Aedes (Finlaya) luteus (Ludlow)

1905. *Popea lutea* Ludlow, Can. Ent. 37: 96 (male). Type locality: Philippines. Camp Stotsenberg, Angeles, Pampanga Prov., Luzon (Whitmore). Type: Male, no longer in existence. However, there is a series of specimens in the U.S.N.M. labeled (apparently in Dr. Ludlow's handwriting) "*Popea lutea* Ludl., female and male cotypes, P.I." This is undoubtedly a subsequent type designation and probably the specimens are those reported by Ludlow (1910: 193).†

1922. *Aedes* (*Finlaya*) *flavipennis* Giles. Edwards, Ind. Jour. Med. Res. 10: 465. In part. Synonymized *lutea*.

1944. *Aedes* (*Finlaya*) *flavipennis* (Giles). Stone and Bohart, Proc. Ent. Soc. Wash. 46: 208. Misidentification. Also: Bohart (1945: 57), Knight and Laffoon (1946: 216), Baisas (1946: 30), and Marks (1947: 62).

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Luzon: Camp Stotsenberg, Angeles, Pampanga Prov.; Mt. Makiling, 2000 ft. Leyte: Abuyog. Samar: Guirang and Calotons, on the Basey River, Basey Municipality. Mindanao: Pasanonca, City of Zamboanga Prov.; Mt. Apo, Cotabato Prov., 3000 ft. (Hoogstraal *et al.*). Basilan: Isabela. A.N.S.P. Leyte: Tacloban; Lagolago, nr. Baybay.

Unknown outside the Philippines.

DISCUSSION: It was not until the type of *flavipennis* was studied by the senior author and the results compared with the types of *aranctana* and *luteus* that it was found that *luteus* represents a valid species. Of course, it is possible that the original type male of *luteus* represented some other black, white, and yellow member of this group. However, since this type is no longer in existence and since we have a series of specimens labeled, presumably by Ludlow, as cotypes of *luteus*, it seems justifiable to take our concept of the species from this series.

The male terminalia and the larva of *luteus* are not separable from those of *croceus*.

Aedes (Finlaya) croceus
Knight and Laffoon

1946. *Aedes* (*Finlaya*) *croceus* Knight and Laffoon, Trans. Amer. Ent. Soc. 72: 213 (males, females, pupae, larvae). Type locality: Philippines. Santa Rita, Olongapo, Subic Bay, Zambales Prov., Luzon (Rozeboom). Type: Male (holotype), with associated larval and pupal skins, in U. S.-N. M.†

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Luzon: Santa Rita, Olongapo, Subic Bay, Zambales Prov. C.A.S. Mindoro: 2 females, assoc. skins, San Jose (Ross).

Unknown outside of the Philippines.

DISCUSSION: Closely related to *luteus*, the male terminalia and the larva apparently being inseparable. Because of this close simi-

larity, it seems quite likely that *croceus* is either a subspecies of *luteus* or else a polymorphic form of it. However, insufficient material is available at present to settle the status of these forms.

Aedes sp., near medleri and flavipennis

There is a single male specimen in the U.S.N.M. which is similar to *medleri* in having the proboscis largely dark-scaled except for a median band, and to *flavipennis* in having the subapical tergal scale tuft of the basistyle long and pale; but it differs from either in that this scale tuft arises in a scattered elongate area extending from the row of stout setae on the basal one-third of the tergal aspect to near the apex of the basistyle, instead of from a compact circular area as in *medleri* and *flavipennis*. This specimen, which was reared from pandanus by J. L. Laffoon, is from Cape Melville, Balabac Island (VI–1945). Whether or not this specimen represents a distinct species can only be determined when more material is available from that area. Deposited in U.S.N.M. as *Finlaya* Sp. 40.

Aedes (Finlaya) melanopterus (Giles)
Figs. 5, 6

1904. *Finlaya melanoptera* Giles, Jour. Trop. Med. 7: 367 (female). Type locality: Philippines. Camp Stotsenberg, Angeles, Pampanga Prov., Luzon (Whitmore). Type: Female (holotype) in B. M.†

1914. *Popea palawanensis* Ludlow, Psyche 21: 30 (female). Type locality: Philippines. Puerto Princesa, Palawan. Type: Female (holotype) in U.S.N.M.†

1917. *Ochlerotatus* (*F.*) *melanopterus* Giles. Edwards, Bul. Ent. Res. 7: 214. Different combination. Synonymized *palawanensis*.

ADULT: A black and white species with prominent white scutal markings. Hind tarsi with incomplete basal and apical bands on I, a narrow basal band on II, remaining segments all dark. King and Hoogstraal (1946: 311) have partially described the male and larva.

Male. Wing length 3.0–3.5 mm. *Head:* Proboscis dark-scaled. Palpus approximately equal to the proboscis in length; dark-scaled; V shorter than IV, the hairs on the apex of III and along IV–V rather sparse, segments IV–V not curved and only very slightly downtilted. Torus bare; some dark scales on the first flagellar segment of antenna. Vertex completely covered with broad white scales, some narrow pale scales on the nape, a band of pale upright-forked scales on the nape (may appear brownish in some lights) and a few scattered anteriorly on the dorsum. *Thorax:* Scutum covered with narrow scales, these white (frequently with a yellowish tinge) except for a transverse band of dark scales at the level of the paratergite (interrupted medially by white scales and with a posterior extension on either side of the prescutellar area) and for an area of dark scales in the postero-lateral corner of the scutum; dorso-central bristles present, acrostichals and prescutellars absent. Scutellum with a patch of narrow white scales on the mid lobe, lateral lobes with a very few hair-like brownish scales. *Apn* with broad white scales; *ppn* with a small dorso-anterior patch of broad white scales. The following pleural areas each with a patch of broad white scales: propleural, paratergite (on the under surface), dorsal sternopleural, medio-posterior sternopleural, and upper mesepimeral (an oblique band extending from the anterior margin in the vicinity of the dorsal sternopleural patch to the dorsal hair tuft). *Legs:* Fore femur with anterior surface dark except for a few basal white scales (one specimen had a dorso-apical white patch), posterior surface marked with a broad pale area from near base to beyond middle; mid femur with anterior surface dark, marked by a ventral white area from near base to beyond middle and by a separate apical white area, posterior surface pale-scaled with a basal dark area and another just

beyond the middle that has a dorsal extension nearly to the apex (this area variable); hind femur pale-scaled, marked anteriorly and posteriorly with a basal and a subapical dark area. Fore tibia with posterior surface pale except for extreme apex, this pale scaling extending onto the anterior surface apically; mid tibia dark except for an apical pale area (some dark scales present on the extreme apex, however); hind tibia dark. Fore tarsus dark; mid tarsus with a broad basal band and an incomplete apical white band on I, a dorso-basal spot on II; hind tarsus with incomplete dorso-basal and apical white bands on I, a narrow incomplete basal band on II, III–V dark. Fore and mid tarsal claws unequal, the larger bidentate, the smaller unidentate; hind claws equal, simple. *Wings:* Dark-scaled, may be a few pale scales at the base of the costa. Halter knob dark-scaled. *Abdomen:* Tergites I, VI, and VII with lateral white bands; II–III with a baso-lateral white area (sometimes forming a nearly complete basal band on III), IV–VII with narrow basal white bands, IV–VII with the median dark scales somewhat erected. Sternites dark-scaled, a basal patch of white scales present on most of them; III–VII with prominent medial tufts of dark elongate erected scales. *Terminalia:* Basistyle without lobes, a prominent patch of setae on basal half of mesal-tergal surface and another medially on mesal-sternal surface. Mesosome simple, slightly expanded apically. Claspette filament expanded subapically in lateral view. Lobes of ninth tergite interrupted.

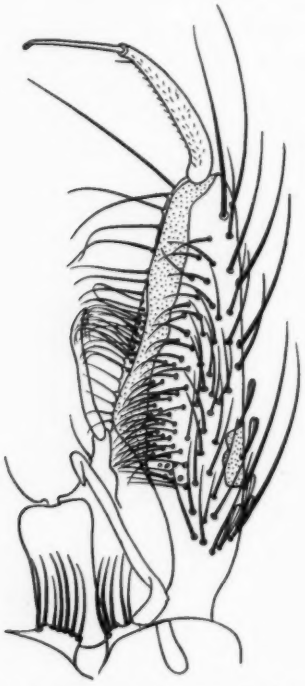

FIG. 5. *A.* (*Finlaya*) *melanopterus.* Male terminalia (Luzon).

The male from Palawan had the transverse dark scutal band broadly interrupted medially.

Female. Wing length about 3.5 mm. Differs from male mainly as follows: Palpus approximately one-fifth as long as the proboscis. Torus with fine dusky hair-like scales medially. Vertex dorsum with broad dark scales (may be a very few pale ones medially), a patch of narrow pale scales anteriorly on the median line and some also on the nape, a line of pale scales along the eyes, and scattered dark upright-forked scales; lateral area with broad white scales. Scutum with narrow scales, dark except for a large anterior area of white scales, a white area before the wing base, and before and along the prescutellar area. Scutellar mid lobe with narrow pale scales, narrow dark scales intermixed laterally; lateral lobe with a few narrow pale scales. Tarsal claws equal, fore and mid each unidentate, hind simple. Tergites dark, IV–VII with a small baso-median white spot, VIII with a broad basal white band, lateral aspect marked as in male.

LARVA. *Head:* Antenna smooth; antennal hair single, inserted at apical one-third. Mouth brush with comb-like tips. Preclypeal spine single, stout. Hair 4 with 4–7 branches, very small; 5 and 6 single; 7 with 2–5; 8 with 2–3; 9 with 2–4; 12 with 4–7; 13 with 1–2; 14 with 1–3; 15 with 4–7; 17 and 18 single or

double; 20 with 1–3. Mentum with 7–10 lateral teeth. *Thorax:* Some of the meso- and metathoracic hairs stellate-type. Prothoracic hair 0 with about 7–10 branches, small, stellate; hair 1 with 2–4 branches; 2 single; 3 with 5–7. Mesothoracic hair 9 with 6–7 branches, very long, stout; 10 and 12 single, long, stout; 11 with 1–3 minute branches. Metathoracic hair 9 with 5–7 branches; 10 and 11 as on mesothorax; 12 single, greatly reduced in size. *Abdomen:* Some of the dorsal and ventral hairs stellate-type. Dorso-lateral hairs of I and II with 3–4 branches. Lateral hairs of I–VI double, rarely triple. Pentad hair 1 with 3–6 branches; 3 with 9–10; 5 with 4–6. Comb with about 28 to 35 scales in a patch, scales apically broadened and completely fringed. Siphon brownish, detached acus present, index 2.4–3.3; 18–29 pecten teeth, each with a strong ventral denticle near middle and a fine fringe from denticle to base; siphon hair tuft inserted beyond middle and shortly before the end of the line of pecten teeth, with 5–9 plumose branches; dorso-lateral valve hair approximately as long as siphon diameter at apex; the two ventro-lateral valve hairs shorter than the valve in length. Anal plate narrowly incomplete, posterior margin heavily spined both above and below *lh*; *lh* with 1–2 branches; *isc* with 4–6; ventral brush of 10 tufts, all but the basal 1–3 tufts arising from a heavily sclerotized, connected barred area, each tuft with 4–8 branches. Anal gills tapered from base, dorsal pair slightly longer than ventral pair and 1.25–1.5 times longer than the anal plate.

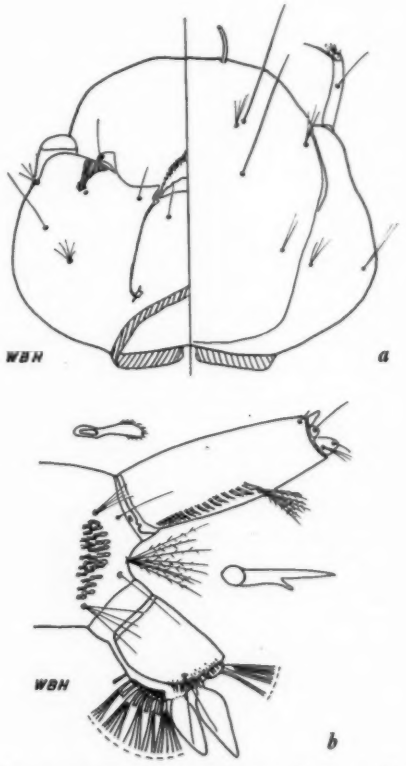

FIG. 6. *A.* (*Finlaya*) *melanopterus*. Larva. *a*, Head (Busuanga); *b*, terminal segments (Leyte).

Four larvae from Tacloban, Leyte, differed from the above series in having the anal gills almost bud-like and the abdominal hairs much less developed. The specimen from Palawan and two of those from Tacloban had a curious medial lateral bulge on the preclypeal spine.

BIONOMICS: The adults were not encountered in nature. All the larval material of this species was taken from various types of tree holes, except for the collection from Busuanga, which was found in a water-holding enameled refrigerator.

DISTRIBUTION: *Specimens examined.* R. K. L. (10 males, 19 females, 23 sets assoc. skins, 1 larva). Luzon: Olongapo, Subic Bay, Zambales Prov. (Rozeboom). Palawan: Balsahan River (Johnson, Laffoon). Culion: Pilapil (Laffoon, Fitzgerald). Busuanga: Coron (Fitzgerald). A.N.S.P. Leyte: Tacloban (Roberts). C.A.S. Mindoro: San Jose (Ross).

Literature records. Palawan: Puerto Princesa (Bohart, 1945: 57).

Unknown outside the Philippines.

DISCUSSION: This species, which is the sole representative of Group B in the Philippines, is closely related to *plumiferus* King and Hoogstraal from New Guinea.

Aedes (Finlaya) aureostriatus (Doleschall)
Fig. 7

1857. *Culex aureostriatus* Doleschall, Nat. Tijdschr. Ned.-Ind. 14: 385 (female). Type locality: Amboina. Type: Non-existent.

1924. *Finlaya greeni* (Theo.) var. *Ranarana* Barraud, Ind. Jour. Med. Res. 11: 850 (male, female). Type locality: India. Karwar, N. Kanara (Barraud). Type: Location not known.

1934. *Aëdes* (*Finlaya*) *greeni* (Theobald) var. *kanaranus* Barraud. Barraud, Fauna Brit. Ind., Dipt. 5: 185. Emendation. Edwards, p. 442 in above reference, questioningly synonymizes *kanaranus*.

ADULT: Scutum with a linear pattern of yellow lines. Hind tarsi with basal and apical markings on I–IV, V largely or all pale dorsally in female.

Male. Wing length about 2.4 mm. *Head:* Proboscis dark. Palpus about three-fourths as long as proboscis; similar in type to that of *saxicola;* all dark. Vertex dorsum with a median longitudinal area of narrow yellow scales (may be a few broad yellow scales marginally), an anterior submedian area of broad dark scales, and a lateral area of broad white scales which extends across the lateral surface, nape with a band of pale upright-forked scales. *Thorax:* Scutum with a pattern of broad yellow-scaled lines as follows: a longitudinal median line to prescutellar area where it forks to the posterior margin (this line of scales is parted medially), a complete longitudinal submedian line, a line or area along lateral margin from the beginning of the subdorsal line to over the wing base, a transverse line from lateral margin along anterior fossa to the subdorsal line, remainder of scutum dark-scaled. Scutellar mid lobe with narrow yellow scales medially, broadened dark scales laterally; lateral lobes with narrow yellow scales. *Apn* with broad pale scales; *ppn* with narrow yellow scales, some broadened scales may occur ventro-posteriorly. The following pleural areas each with a patch of broad white scales: propleural, subspiracular, prealar, dorsal sternopleural, mediposterior sternopleural, and mesepimeral. *Legs:* Fore and mid femora anteriorly dark, a small basal pale area and a few scattered pale scales along the ventral margin. Hind femur pale anteriorly, with a subapical dark band that extends basally along the anterior margin. Tibiae dark, a ventral area of pale scaling basally. Fore tarsus dark. Mid tarsus with a basal band on I, some indefinite pale scaling over the junction of I and II. Hind tarsus with basal and apical bands on I–III, a basal band on IV, complete only on I and at the base of II, V dark or else palish above. *Wings:* Dorsally dark-scaled. Halter knob dark-scaled. *Abdomen:* Tergites dark-scaled, I with a lateral white band, II–VI with baso-lateral silvery-white spots, a few basal white scales medially on some of the segments. Sternites with basal silvery bands. *Terminalia:* Tergal surface of basistyle with a group of elongate bristles apically and a group of short ones basally; below this basal setose area and

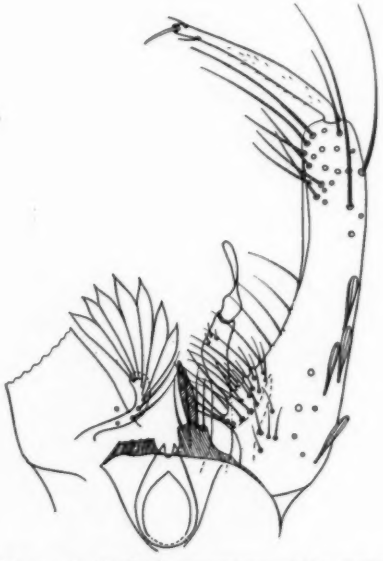

FIG. 7. *A.* (*Finlaya*) *aureostriatus*. Male terminalia (Mindoro).

tergally attached to the base of the claspette is a slender elongate detached lobe that bears a curving line of blade-like scales (omitted from right side of figure but shown isolated on left side); inner tergal margin with a line of stiff setae from base to near middle. Claspette filament a twisted blade-like structure.

Female. Wing length about 2.5 mm. Differing from the male as follows: Palpus about one-fifth as long as proboscis, dark. Torus not scaled. Hind tarsal V with dorsal pale scaling (probably for whole length but difficult to make out on the single specimen at hand). Tergite VII with a complete basal band.

The female from Culion differs from the above specimen as follows: Median scutal line not parted down the middle, the anterior portion of the submedian line and the line along the anterior fossa largely obsolete, all of the scutal markings more reduced in size. Hind tarsus with basal and apical banding on I–IV, V definitely white-scaled dorsally for its whole length. Complete basal bands on tergites III–VII.

LARVA: Apparently identical to the larva of *leucopleurus* except for the following points: Head hair 5 (present on one side only) with 5 branches. Lateral hairs on abdominal segments I and II are stouter, and the lateral hair on II is the same length as the lateral hair on I. All ventral brush tufts arising from a connected barred area. A detached acus is present on the anal plate of the single specimen examined.

BIONOMICS: The adults were not encountered in nature. Both the larval collections were from tree holes.

DISTRIBUTION: *Specimens examined*. R.K.L. Culion Island: 1 female, Pilapil (Laffoon, Fitzgerald). C.A.S. Mindoro: 1 male, 1 female, 1 set assoc. skins, San Jose (Ross).

Outside of the Philippines this species is known from Sumatra, Java, Celebes, Kabaena, Alor, Soembawa, Timor, Ceram, Amboina, Dutch New Guinea, and India.

DISCUSSION: Not previously known from the Philippines.

The identification of these specimens is based upon a comparison with a series of specimens from Hollandia, New Guinea, of what is believed to be *aureostriatus*. However, as the type of *aureostriatus* is non-existent, this latter identification can only be regarded as provisional. The New Guinea specimens differ slightly as follows: The upright-forked scales of the vertex are brown, the lateral scutellar lobes have brown narrow scales, and the abdominal tergal bands are incomplete except occasionally on VI–VII, the lateral larval hair on abdominal segment I is stouter, and the lateral larval hair on segment II is double, stout, and long (rather than single, short, and slender). The male terminalia appear to be completely similar. The scutal markings are exactly similar to those of the female specimen from Culion.

Aedes (*Finlaya*) *aureostriatus* var. *greeni* (Theobald), known from India, Ceylon, Assam, Sumatra, and Java, is apparently separable from the type species only on the basis of the suffused nature of the scutal pale scale pattern. It is possible that the Mindoro specimens should be considered this variety. The type of *greenii*, which has been seen by us, has the upright-forked scales yellow, the lateral scutellar scales brown, and complete abdominal bands on tergites III–VI.

On the basis of the remarks by Edwards (in Barraud, 1934), *kanaranus* is here regarded as a synonym of *aureostriatus*. The location of the type of this form is at present unknown.

Aedes (*F.*) *okinawanus* Bohart from Okinawa is very closely related to *aureostriatus*, apparently differing only slightly on details of the male terminalia.

Aedes (Finlaya) saxicola Edwards

1908. *Hulecoeteomyia fluviatilis* Leicester (nec Lutz, 1904), Cul. Malaya, p. 111 (male, female). Type locality: Malay Peninsula. Ulu Gombak (Leicester). Type: Non-existent.

1922. *Aedes* (*Finlaya*) *saxicola* Edwards, Ind. Jour. Med. Res. 10: 466 (nom. nov.).
1923. *Finlaya greigi* Barraud, Bul. Ent. Res. 13: 406 (male, female). Type locality: Assam. Haflong, Cachar Hills (Barraud). Type: Male, female (cotypes) in B. M.†
1932. *A.* (*F.*) *saxicola* Edwards, Gen. Insect., Fasc. 194: 151. Synonymy of *greigi*.
1946. *Aedes* (*Finlaya*) *rizali* Banks. Baisas, Phil. Bur. Health Mon. Bul. 22: 21. Misidentification.

Adult and larva have been described by Barraud (1934: 191) and Knight (1947*b*: 628).

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Palawan: Puerto Princesa. Irahuan and Balsahan Rivers.

Outside of the Philippines it is known from Malaya, Java, Siam, and India.

DISCUSSION: There are four larval specimens from Palawan deposited in the U. S. National Museum as *Finlaya* sp. No. 42 that possibly represent a species near to *saxicola*. They have been described by Knight (1947*b*: 647). The differences between these larvae and that of *saxicola* apparently consist entirely of the possession by the former of more heavily branched hairs. This difference, although striking in appearance, is a rather minor one. Consequently, they may represent only a polymorphic form of *saxicola*, rather than a new species.

Aedes (Finlaya) abadsantosi Baisas

1946. *Aedes* (*Finlaya*) *abadsantosi* Baisas, Phil. Bur. Health Mon. Bul. 22: 25 (male, female, pupa, larva). Type locality: Philippines. Llavac, Infanta Municipality, Tayabas Prov., Luzon (Baisas). Type: Male (holotype), with associated larval and pupal skins, in the Philippine Bureau of Health, Manila. Terminalia separated.

Adult and larva also described in detail by Knight (1947*b*: 641).

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Samar: Osmena and Sohoton Springs, on Basey River. Mindanao: San Ramon, Zamboanga Prov. A.N.S.P. Leyte: Lagolago, nr. Baybay, Dagami. Samar: Osmena.

Literature records. Luzon: Upper Molawin Creek, Los Banos Agr. Coll., Laguna Prov. Type series, Llavac, Infanta Municipality, Tayabas Prov. (Baisas, 1946: 25).

Unknown outside the Philippines.

DISCUSSION: This and the following three species (*burgosi*, *rizali*, and *sherki*) are all very closely related and probably represent either a polymorphic or a polytypic species. Quite likely, *jugraensis* can also be included within this complex. However, the available collection data are too meager to solve this problem.

Aedes (Finlaya) burgosi Baisas
Fig. 8

1946. *Aedes* (*Finlaya*) *burgosi* Baisas, Phil. Bur. Health Mon. Bul. 22: 27 (males, females, larvae, pupae). Type locality: Philippines. Titunod Creek in Kolambugan, Lanao, Mindanao (Guinto). Type: Male (holotype), non-existent. Paratypes in the Philippine Bureau of Science, Manila, and in the U.S.N.M.

DISTRIBUTION: Known definitely only from the type series.

DISCUSSION: From the discussion of this species by Knight (1947*b*: 643), it would appear that *burgosi* probably represents only a polymorphic form of *abadsantosi*. The adults are not separable on external characters. The male terminalia differ only in that *burgosi* possesses 12–30 bristles on each lobe of the ninth tergite, whereas *abadsantosi* has 4–10 bristles on each lobe. The larva of *burgosi* differs from *abadsantosi* on the greater number of branches of some of the hairs, and on the pecten not having any of the teeth distinctly out of line ventrally.

If the series of specimens from Mt. Apo, Davao, Mindanao, described by Baisas (1946:

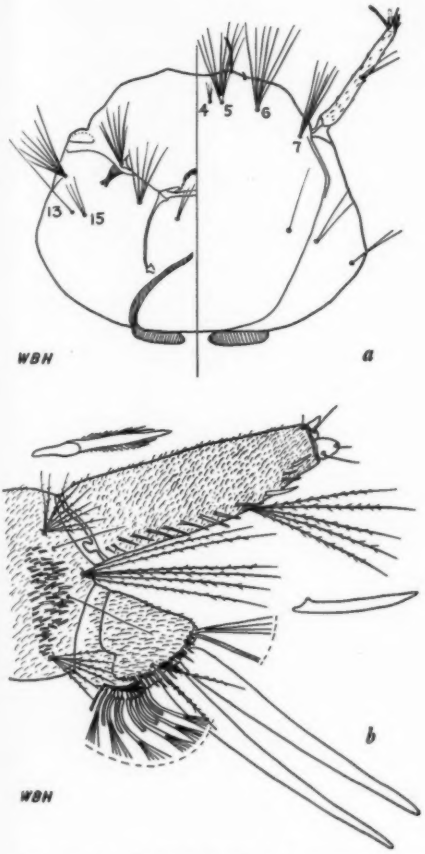

FIG. 8. *A.* (*Finlaya*) *burgosi.* Larva (Mindanao). *a*, Head; *b*, terminal segments.

28) are considered to be *burgosi*, even the male terminalic difference disappears because these specimens have a range of only 9–11 bristles on each ninth tergite lobe.

Aedes (Finlaya) rizali (Banks)

1906. *Culex rizali* Banks, Phil. Jour. Sci. 1: 999 (2 females). Type locality: Philippines. Volcano Canlaon, Mt. Siya-Siya, at altitude of 760 m., Negros Occidental Prov., Negros Island (Banks). Type: Female (holotype), non-existent.

1922. *Aedes* (*Finlaya*) *rizali* Banks. Edwards, Ind. Jour. Med. Res. 10: 466. Different combination.

DISTRIBUTION: Known only from the type series.

DISCUSSION: The status of this species has been discussed by Knight (1947*b*: 644). As stated above, *rizali* has apparently not been retaken since Banks' type series was collected; nor have any additional notes ever been published on the types (destroyed during World War II). However, it must be very closely related to *abadsantosi* and *burgosi*, the only significant difference apparent from a study of the type description being the complete or nearly complete tergal bands of the latter two species (always complete on VIII). The extent of the tergal markings is subject to so much variation in this group of species that it is even possible that this character does not offer a valid distinction. Consequently, until material is again collected from the type locality of *rizali* its exact status will probably remain undetermined. With only the type description to go on, this species is also not separable from *jugraensis*.

The novotype material designated for *rizali* by Baisas (1946: 21) is cospecific with *saxicola*.

Aedes (Finlaya) sherki Knight

1947. *Aedes* (*Finlaya*) *sherki* Knight, Ann. Ent. Soc. Amer. 40: 645 (males, females, pupae, larvae). Type locality: Philippines. Baguio, City of Baguio Prov., Luzon (Rozeboom). Type: Male (holotype), with associated larval and pupal skins, in the U. S. N. M.†

DISTRIBUTION: Known only from the type series. However, the type series is the result of four separate collections (and all by different people) so that the species must be well established at Baguio.

DISCUSSION: This species is only definitely distinct from the preceding three by the

presence of a basal white patch or band on segment IV of the hind tarsus. No definite character for the separation of the larva of *abadsantosi* and the larva of *sherki* has been found. All characters examined seemed to show sufficient intergradation to render them useless for positive identification. Consequently, it seems likely that *sherki* represents, at the most, only a subspecies of *abadsantosi*.

As pointed out in the type description, the larva is polymorphic.

Aedes (Finlaya) jugraensis (Leicester)
Fig. 9

1908. *Helecocteomyia jugraensis* Leicester, Cul. Malaya, p. 109 (male, female). Type locality: Malaya. Jugra (Leicester). Type: Male, female (cotypes), non-existent. Note: Error in generic name spelling.

1922. *Aedes* (*Finlaya*) *jugraensis* Leicester. Edwards, Ind. Jour. Med. Res. 10: 466. Different combination.

Adult described by Knight (1947*b*: 647) and larva by Edwards and Given (1928: 343), both from Malayan material. The following larval description is based upon two Philippine specimens and constitutes the first record of this species in the Philippines. No adults were taken.

LARVA: *Head:* Antenna slender, a few small spicules present; antennal hair double, inserted just beyond middle. Mouth brush with prominent comb-like tips. Hair 4 double, small; 5 and 6 with 3–4 branches; 7 with 3–5; 8 single; 9 double; 12 with 3–4; 13 single; 14 with 1–2; 15 with 3–4; 17 with 3–8; 18 with 1–2; 20 with 2–4; hairs 4, 5, and 6 are all in a straight line. Mentum with 11–13 lateral teeth. *Thorax:* Prothoracic hair 1 with 3 branches; 2 with 1; 3 with 3; all rather large and borne together on a sclerotized plate. A stout spine occurs at the base of the pleural hair tufts. Hair 1 of the mesothorax single, stout, darkly pigmented; hair 7 of metathorax with 4 branches, each short, very stout, darkly pigmented, and barbed. *Abdomen:* Dorsolateral hairs on I and II double. Lateral hairs on I and II single; on III to VI double, once triple. Pentad hair 1 with 2–3 branches; 2 and 4 single; 3 with 4–7; 5 with 2–4. Comb with 14 to 19 large scales in a patch or double row, each scale pointed and fringed laterally. Segment VIII and anal segment ventral to anal plate pilose. Siphon incomplete basally, with an attached acus, index 2.4–3.0; 9–11

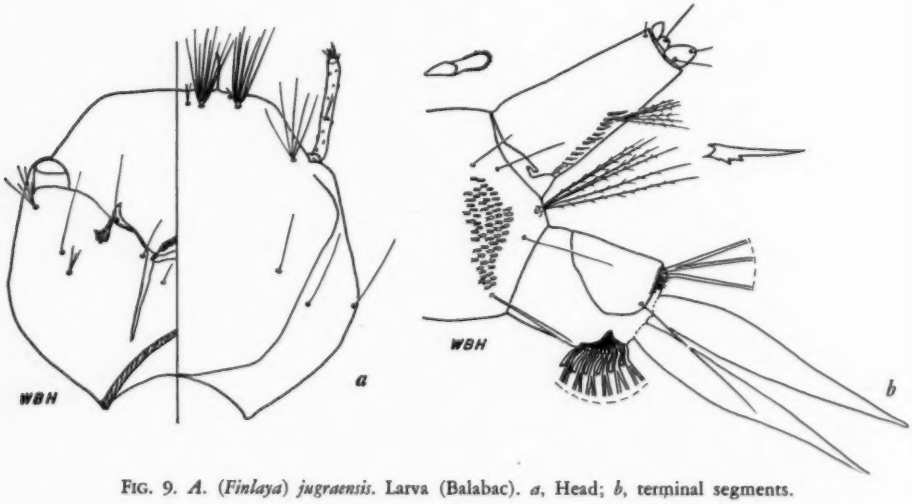

FIG. 9. *A.* (*Finlaya*) *jugraensis*. Larva (Balabac). *a*, Head; *b*, terminal segments.

pecten teeth in an even row, none beyond siphon tuft, each tooth with 1 or 2 ventral denticles; siphon hair tuft with 3–5 branches. Anal plate broadly incomplete, with a row of short spines on posterior margin; *lh* single, stout; *isc* with 3–6 branches, *osc* single; ventral brush of 12 tufts, each tuft with 2–6 branches, sometimes one tuft off the barred area basally; barred area joined laterally by a sclerotized line. Anal gills long, tapering, subequal, about 3.0 times longer than anal plate.

DISTRIBUTION: *Specimens examined.* R.K.L. Balabac Island: 2 larvae, Cape Melville (Johnson).

Outside of the Philippines this species is known only from Malaya.

DISCUSSION: Since the male terminalia of *jugraensis* has not been described, it is impossible to discuss its exact relationship with the closely related group of four species just preceding (*abadsantosi*, *burgosi*, *rizali*, and *sherki*). However, there is no question but that it is closely related to this group.

Aedes (Finlaya) spp., near abadsantosi

In the British Museum collection there is a female specimen from the Philippines that possibly represents an unknown species. It closely resembles *abadsantosi* except that the anterior portion of the postspiracular scale patch consists of narrow yellowish scales and does not extend to the ventral margin of the spiracle. All of the abdominal tergites are dorsally dark except for a complete basal band on VIII. The specimen has the following data: Mt. Mupo, Dansalan, Mindanao, 28–III–1920 (Dr. A. Moore).

In the collection of the Academy of Natural Sciences of Philadelphia, there is a female specimen, Lagolago, Leyte (H. R. Roberts), with the postspiracular scales similar to those of the above specimen but differing in having the tergites with complete basal bands.

Also, in the U. S. National Museum there is a male specimen, with associated larval and pupal skins, which cannot be separated from *abadsantosi* except on male terminalia. The claspette filament is slender and tubular instead of being laterally flattened (this is utterly unlike anything known in this group), and there are 11–13 hairs on each of the ninth tergite lobes. The data for this specimen are: San Ramon, Mindanao (Knight and Laffoon), reared from rock hole in hill stream, 17–IX–1945.

Aedes (Finlaya) banksi Edwards
Figs. 10, 11

1906. *Hulecoetomyia pseudotaeniata* Giles. Banks, Phil. Jour. Sci. 1: 986. Misidentification of specimens from Luzon.

1922. *Aedes* (*Finlaya*) *banksi* Edwards, Ind. Jour. Med. Res. 10: 270 (males, females). Type locality: Philippines. Montalban, Rizal Prov., Luzon (Banks). Type: Male (holotype) in B. M.† Terminalia mounted.

ADULT: Characterized by the pattern of narrow sharply defined yellow lines on the scutum, by the median pale-scaled longitudinal line along the anterior surface of the mid femora, and by the hind tarsi having basal and apical bands on segments I–IV and with V all white dorsally.

Male. Wing length about 2.8 mm. *Head:* Proboscis dark. Palpus slightly shorter than the proboscis; dark, basal half of V white-scaled dorsally; a number of hairs apically on III and laterally along IV–V. Vertex dorsum with a median longitudinal stripe of narrow pale scales (some also present on the nape), remainder broad-scaled, the dorsal portion being dark-scaled and marked with a longitudinal white band medially, a line of pale scales along the ocular margin; the lateral surface of vertex with broad pale scales; dark upright-forked scales scattered over the dorsum. *Thorax:* Scutum covered with narrow dark scales, marked with sharply defined thin longitudinal lines of narrow yellowish scales as follows: A median line that forks at the

prescutellar space, a short subdorsal line beginning near the anterior margin and extending posteriorly to the level of the fossae, a line curving mesally along the fossae and then extending straight back to the posterior margin of the scutum, a short line above the wing base, and an even shorter line or patch on the lateral margin just above the paratergite; dorso-central, acrostichal, and prescutellar bristles present. Scutellum with small broad dark scales on the mid lobe, some pale scales may be present basally, lateral lobes with sparse narrow pale scales. *Apn* with broad pale scales; *ppn* with a line of narrow-curved pale scales along dorsal margin, broadened dark scales centrally, and a small patch of broadened pale scales ventrally. The following pleural areas each with a patch of broad pale scales: Propleural, subspiracular, postspiracular, paratergite, sub-prealar, dorsal sternopleural, medio-posterior sternopleural, and mesepimeral. *Legs:* Fore femur with anterior surface dark except for a thin longitudinal white line very near to the ventral margin, mid femur similar except the line is median, hind femur similar except the line is broader and is near to the dorsal margin for at least a portion of its course. Fore tibia with an apical pale band, mid tibia may have a broken white-scaled anterior line, all of the tibiae with a short ventro-basal area of pale scaling. Fore tarsus dark, mid tarsus with a basal white band on I and usually some apical pale scales; hind tarsus with basal and apical bands on I–IV (apical pale area on IV incomplete ventrally), V all white on dorsal surface. Fore and mid tarsal claws unequal, the larger bidentate, the smaller unidentate; hind tarsal claws equal, simple. *Wings:* Dark-scaled, a short subbasal pale area on the costa. *Abdomen:* Tergite I with a lateral band of pale scales, II with a small medio-basal pale spot, III–VI with basal white bands. Sternites with basal white bands. *Terminalia:* Basistyle without basal and apical lobes, lateral surface heavily scaled (omitted in figure). Claspette appendage elongate, slender, only slightly broadened in lateral view.

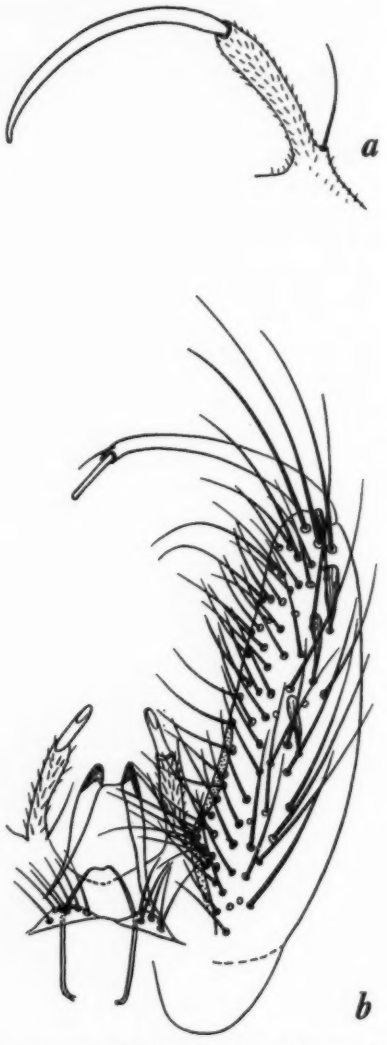

FIG. 10. *A.* (*Finlaya*) *banksi.* Male terminalia. *a,* Lateral aspect of claspette (Samar); *b,* terminalia (Mindanao).

Female: Differs from male chiefly as follows: Palpus approximately one-fourth as long as the proboscis, apex pale-scaled, a small subbasal pale patch usually present. Torus with pale scales medially. Fore tarsus with a narrow

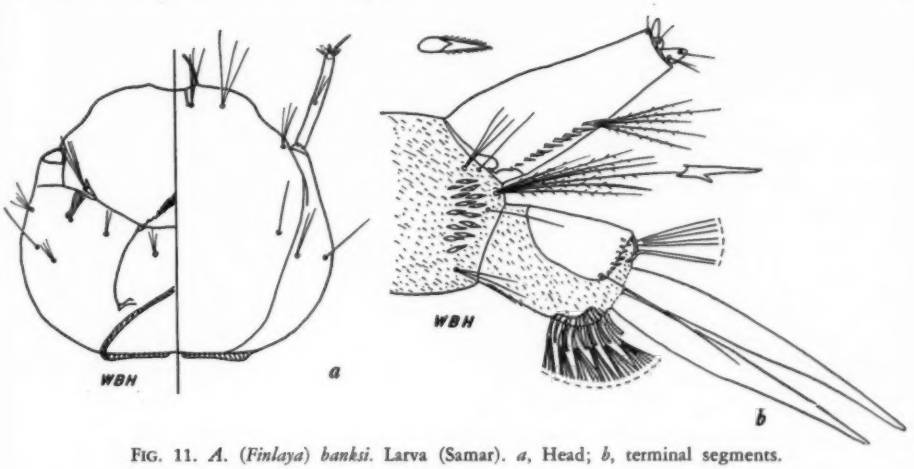

FIG. 11. *A.* (*Finlaya*) *banksi.* Larva (Samar). *a*, Head; *b*, terminal segments.

basal pale band on II, may be some apical pale scaling on I; mid tarsus with small basal bands on I–IV and apical pale scaling on I–II. Tarsal claws equal, fore and mid each unidentate. Tergites II–VI and VIII with basal bands, VII with a baso-lateral white patch, and sometimes a small medio-basal spot.

The series of specimens from Mindoro and Jolo differ slightly from the Samar series in having hind tarsal segment IV all white dorsally (was very narrowly interrupted on two specimens). Also, the subbasal white patch on costa is frequently obsolete dorsally or reduced to a line of scales on the anterior margin only.

LARVA: *Head:* Antenna spiculated, antennal hair double (occasionally single), inserted before middle. Mouth brushes with prominent comb-like tips. Hair 4 small with 1–5 branches; 5 with 7–12; 6 with 7–11; 7 with 3–6; 8 single; 9 single or double; 12 with 3–6; 13, 14, and 17 single; 15 with 3–5; 18 and 20 single or double. Mentum with 12–15 lateral teeth. *Thorax:* Prothoracic hairs 1 and 2 single, hair 3 with 2–3 branches; this group borne together on a small sclerotized plate. Mesothoracic hair 9 with 5–6 branches; hairs 10 and 12 single, stout; hair 11 single, very small. Metathoracic hair 9 with 4 branches; 10 single, stout; 12 greatly reduced. *Abdomen:* Dorso-lateral hairs on I and II double. Lateral hair on I single or double; on II to V double; on VI single. Pentad hair 1 with 1–3 branches; 2 and 4 single; 3 with 4–8; 5 with 1–4. Comb of 40–61 scales in a patch, the scales rounded and fringed apically and laterally. Siphon with acus narrowly attached, rarely detached, index 1.2 to 2.0; 12–25 pecten teeth in a straight row with ventral denticles; siphon hair tuft with 4–11 branches, length less than width of siphon. Anal plate incomplete, with a patch of spines on the posterior lateral margin; *lh* single, stout; *isc* double, *osc* single; ventral brush with 11–13 tufts on a barred area, the tufts with 2–3 branches; barred area connected on each side to a sclerotized plate. Anal gills subequal, broadest at base and tapering sharply to a long slender point; dorsal gills 2.7–3.4 times longer than the anal plate.

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Luzon: 4 larval skins, 1 larva, Baguio, City of Baguio Prov. 8 larvae, Burgos, Mountain Prov. R.K.L. Samar: 4 males, 20 females, 14 sets assoc. skins, 2 larvae, Kenamatayan River, Osmena (Knight, Laffoon, Rozeboom). Mindanao: 2 males, 9 females, 8 sets assoc. skins, San Ramon (Johnson, Laffoon, Knight). Basilan: 1 male, 3 females,

3 sets assoc. skins, 4 kilometers from Isabela (Knight). C.C. Luzon: 8 males, 38 females, 6 larvae, Antamok, Mountain Prov. (Franclemont).

Literature records. Luzon: Gorge Camp, Manila waterworks, Rizal Prov. (Banks, 1906: 986).

Unknown outside the Philippines.

DISCUSSION: This species, which is the sole representative of Group E in the Philippines, is closely related to *pseudotaeniatus* (Giles) of India. However, *pseudotaeniatus* is distinct from *banksi* in having hind tarsal segment V all dark. Other minor color variations also occur. Male terminalia and larvae are very similar.

Aedes (Finlaya) harperi Knight

1948. *Aedes* (*Finlaya*) *harperi* Knight, Proc. Ent. Soc. Wash. 50: 4 (males, females, pupae, larvae). Type locality: Philippines. Zig-Zag Pass, Subic Bay, Zambales Prov., Luzon (Rozeboom and MacMillan). Type: Male (holotype) in U. S. N. M.† Terminalia mounted.

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Type series. Luzon: Zig-Zag Pass, Olongapo, and Matain, all in Subic Bay area, Zambales Prov.

Unknown outside the Philippines.

DISCUSSION: This species, which is the sole representative of Group F in the Philippines, is closely related to *stevensoni* (Barraud) of India. However, *stevensoni* differs as follows: vertex without a white median area; only the first three hind tarsal segments banded (sometimes a trace of a marking on IV); female tergites without complete bands except VIII, which is all white; and the basal white-scaled area on costa very small. The larva is unknown.

Aedes (Finlaya) niveus (Ludlow)
Fig. 12

1903. *Stegomyia niveus* Ludlow,, Jour. N. Y. Ent. Soc. 11: 139 (female). Type locality: Philippines. Oras, Samar. Type: Female (lectotype) in B. M.†

1905. *Scutomyia nivea* Ludlow. Theobald, Gen. Insectorum, Cul., p. 19. Different combination.

1910. *Stegomyia pseudonivea* Theobald, Mon. Cul. 5: 176 (male). Type locality: Andaman Islands (Lowis). Type: Male (allotype) in the B. M.† Terminalia mounted.

1917. *Aëdes* (*Ochlerotatus*) *niveus* Ludl. Edwards, Bul. Ent. Res. 7: 211. Different combination.

1923. *Finlaya nivea* (Ludl.). In part. Barraud, Ind. Jour. Med. Res. 11: 480. Different combination.

1931. *Aedes* (*Finlaya*) *niveus* (typus) (Ludlow). Brug, Arch. Hydrobiol. Suppl.-Bd. 9: 25. First association of male terminalia and larva. Sumatra and Bali.

1932. *A.* (*F.*) *niveus* Ludlow. Edwards, Gen. Insectorum, Cul., Fasc. 194, p. 154. Synonymy of *pseudonivea* Theobald, 1910 (male only). Pointed out that the female of *pseudonivea*, described by Theobald (1905: 75), is a distinct species.

Adult and larva are described by Barraud (1934: 208) and Knight (1946: 278).

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Luzon: Batangas, Batangas Prov.; Subic Bay, Zambales Prov. Samar: Oras. Palawan: Puerto Princesa, Irahuan River, and Tacburos. Busuanga: 1 larva, Coron (Fitzgerald). A.N.S.P. Leyte: Tacloban (Roberts). C.A.S. Mindoro: 3 males, 3 females, San Jose (Ross).

Literature records. Of the Philippine records given by Bohart (1945: 58), only that for Oras is definitely this species.

From outside the Philippines there are apparently reliable literature records from South Bengal, Ceylon, Andaman Islands, Sumatra, Bali, Java, Flores, Malacca, Borneo, and Siam. The records from China and Japan are probably not for this species.

DISCUSSION: This species and the following three are members of the *niveus* subgroup

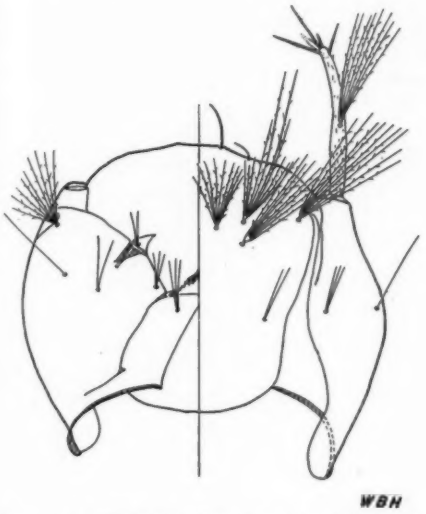

FIG. 12. *A.* (*Finlaya*) *niveus*. Larval head (Palawan). Drawn from exuvium.

of Group H. The *niveus* subgroup, consisting at present of 12 valid species and subspecies, is distributed throughout the Oriental Region. Although insufficient data are available at present, it appears to be at the superspecies stage in development.

Since the appearance of the treatment of the *niveus* subgroup by Knight (1946), the senior author has had the opportunity of seeing the lectotype of *niveus* and the male allotype of *pseudonivea* in the British Museum. The terminalia of the latter was separated and examined. Both specimens were found to be typical *niveus* as treated here.

Knight (1946: 278) described the female scutum as having the anterior two-thirds solidly white-scaled. However, in a number of the specimens from Leyte and in one of the three females from Mindoro listed in the distribution section above, the white scutal patch is interrupted posteriorly for as much as three-fourths of its depth by a median extension of the posterior dark-scaled area.

Apparently the female of this species is not definitely separable from that of *lacteus*. However, it is possible that the palpi are shorter in *lacteus* (about one-eighth length of proboscis in few observed cases) than they are in *niveus* (one-fifth to one-sixth as long).

Aedes (Finlaya) lacteus Knight

1946. *Aedes* (*Finlaya*) *lacteus* Knight, Jour. Wash. Acad. Sci. 36: 275 (male, female, larvae). Type locality: Philippines. Cape Melville, Balabac Island (Laffoon and Johnson). Type: Male (holotype) in U. S. N. M.† Terminalia mounted.

DISTRIBUTION: Known only from the type series of one male, one female, and two larvae. A female specimen in the U.S.N.M. from Parang, Mindanao (Paullus), is possibly this species, but in the absence of a male positive identification is not possible.

DISCUSSION: This species possibly represents only a polymorphic form of *niveus*, being closely similar to it in the adult and larval stages.

Externally, the male is not definitely separable from that of either *niveus* or *laoagensis*.

Aedes (Finlaya) saperoi Knight
Fig. 13

1946. *Aedes* (*Finlaya*) *saperoi* Knight, Jour. Wash. Acad. Sci. 36: 271 (males, females, larvae). Type locality: Philippines. Subic Bay, Luzon (Zedeck and Zolik). Type: Male (holotype), with associated larval and pupal skins, in U. S. N. M.† Terminalia mounted.

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Luzon: Subic Bay, Zambales Prov. Mindanao: 4 females, 3 sets assoc. skins, Pasanonco, Zamboanga (Laffoon). 3 males, 3 females, Kisante, Kidapawan, Cotabato Prov. (Enke, Corcega).

Unknown outside the Philippines.

DISCUSSION: The Pasanonco specimens listed above were treated by Knight (1946: 280) as an unidentified species. The later

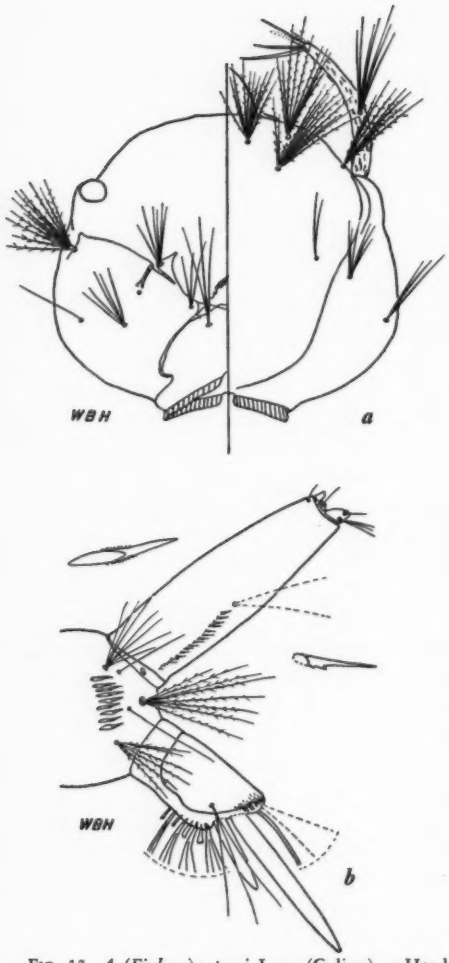

FIG. 13. *A. (Finlaya) saperoi.* Larva (Culion). *a*, Head; *b*, terminal segments.

opportunity of seeing male terminalia from the Cotabato series showed all the Mindanao specimens to be *saperoi*, differing from the previously known specimens in having the apical dark area of the hind femur broadly complete on the anterior aspect.

A re-examination of the larval specimen (Fig. 13) from Culion Island, tentatively named as *albolateralis* (Theobald) by Knight (1946:279), has shown it to be equally similar to *saperoi*. Because of this finding, *albolateralis* has been dropped from the Philippine species list. However, the Culion specimen is included in the larval key under the name *albolateralis* to call attention to the possibility that this species may still be found to occur in the Philippines.

This species is very similar to *laoagensis*.

Aedes (Finlaya) laoagensis Knight

1946. *Aedes* (*Finlaya*) *laoagensis* Knight, Jour. Wash. Acad. Sci. 36: 276 (males, female, larva). Type locality: Philippines. Laoag, Ilocos Norte Prov., Luzon (Hoogstraal). Type: Male (holotype) in U. S. N. M.† Terminalia mounted.

DISTRIBUTION: *Specimens examined.* U.S.-N.M. Luzon: Laoag, Ilocos Norte Prov.; Baguio, City of Baguio Prov.; Subic Bay, Zambales Prov.; San Fernando; Rizal Prov.; Laguna Prov.; Tayabas Prov.

Unknown outside the Philippines.

DISCUSSION: Distinguishable from the other species of the *niveus* subgroup in the Philippines on the divergence of the scutal white-scaled area from the lateral margin over the paratergite in the female. Although the terminalic characters differ slightly, the male does not differ externally from *saperoi*. The larva is not distinguishable with certainty from that of *saperoi* except possibly on the number of branches of the antennal hair tuft and on the spiculation of the posterior margin of the anal plate.

Aedes (Finlaya) paradissimilis Rozeboom

1946. *Aedes* (*Finlaya*) *paradissimilis* Rozeboom, Jour. Parasit. 32: 587 (males, females, pupae, larvae). Type locality: Philippines. Cape Melville, Balabac (Johnson and Laffoon). Type: Male (holotype), with associated larval and pupal skins, in U. S.-N. M. Terminalia mounted.

DISTRIBUTION: *Specimens examined.* C.A.S. Mindoro: 4 males, 4 females, 9 sets assoc. skins, San Jose (Ross).

Literature records. Leyte: Lagolago, Baybay; Libjo, Dinagat Island; Diit River, Tacloban. Calicoan Island (nr. Samar): N'golos. Palawan: Irahuan River. Balabac Island: Cape Melville (Rozeboom, 1946: 588).

Unknown outside the Philippines.

DISCUSSION: This species and the following three are members of the *dissimilis* subgroup of Group H. The *dissimilis* subgroup, consisting at present of five valid species and subspecies and of one unrecognized name (*leucomeres*), is distributed over Malaya, India, China, and the Philippines. The members of this subgroup are all extremely similar and probably constitute either a polytypic species or a superspecies.

A. paradissimilis appears to be most closely related to *dissimilis* (Leicester) from India and Malaya, but is stated by Rozeboom (1946: 590) to differ from that species in larval characters.

Aedes (Finlaya) leucopleurus Rozeboom

1946. *Aedes* (*Finlaya*) *leucopleurus* Rozeboom, Jour. Parasit. 32: 588 (male, pupa, larvae). Type locality: Philippines. Irahuan River, Palawan (Johnson and Laffoon). Type: Male (holotype), with associated larval and pupal skins, in U. S. N. M. Terminalia mounted.

DISTRIBUTION: Known only from the type series. Palawan: Irahuan River. Culion Island: Pilapil. This series is divided between the U.S.N.M. and the B.M.

DISCUSSION: Distinguishable from *paradissimilis*, only in the larval stage, by the following characters: Head hairs 4, 5, and 9 and prothoracic hair 0 each with a greater number of branches; posterior process of mandible truncate; lateral hair on abdominal segment II only about one-half the length of that on I; and apical fringe of comb scales without a stout central spine.

The female is unknown.

Aedes (Finlaya) luzonensis Rozeboom

1946. *Aedes* (*Finlaya*) *luzonensis* Rozeboom, Jour. Parasit. 32: 589 (males, females, pupae, larvae). Type locality: Philippines. Subic Bay, Zambales Prov., Luzon (MacMillan). Type: Male (holotype), with associated larval and pupal skins, in the U. S. N. M. Terminalia mounted.

DISTRIBUTION: *Specimens examined.* C.A.S. Mindoro: 2 males, 4 females, 2 sets assoc. skins, 1 larva, San Jose (Ross).

Literature records. Type series. Luzon: Subic Bay, Zambales Prov.

Unknown outside the Philippines.

DISCUSSION: The adult of this species is separable from those of *paradissimilis* and *leucopleurus* by the presence of 2–3 hairs of about equal size at the apex of the claspette of the male terminalia. The larva differs mainly in having the lateral hair of abdominal segments I and II paler, slenderer, and more branched, and of segments III–V more branched; and on the structure of the pecten teeth.

Aedes (Finlaya) leucomeres (Giles)

1904. *Stegomyia leucomeres* Giles, Jour. Trop. Med. 7: 367 (female). Type locality: Philippines. Camp Stotsenberg, Pampanga Prov., Luzon (Whitmore). Type: Female (holotype) in B. M.†

This species is known only from the type female. This specimen has been examined and found to be somewhat damaged. The antennae, fore and hind legs, and one mid leg are entirely missing, and the scutum is rubbed bare over the median area. The type was compared with paratype females of *paradissimilis* and *luzonensis*. It was found similar to *luzonensis* in having two pale setae on the upper part of propleuron but differed in having a short median spot on the mid femur (rather than one that is one-half the length

of the femur), and in having this spot extending onto the ventral aspect. The type differed from *paradissimilis* only in having two, rather than one, propleural bristles.

Since the members of the *dissimilis* subgroup cannot be adequately distinguished in the female, the true relationship of *leucomeres* is unknown at present.

As Rozeboom (1946: 590) pointed out, the two anterior scutal spots described by Giles from the type are actually the silvery scale patches on *ppn*. No scutal markings are apparent now on the type.

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Notes on *Tetrameres* sp. (Nematoda, Spiruroidea) Parasitic in the English Sparrow in Hawaii

LEO KARTMAN[1]

WHILE ENGAGED by the University of Hawaii Agricultural Experiment Station in 1947, the writer participated in a study of wild birds as possible carriers of poultry parasites. During the course of this work incidental observations were made on a species of *Tetrameres* parasitic in *Passer domesticus*. A more thorough study of this parasitic nematode was then contemplated, but it now appears that such a project may not be feasible. Since the parasite in question is undoubtedly a new species[2] and some worker may wish to describe it, it seems desirable that these notes be recorded to serve as a basis for future work.

In her treatise on bird nematodes, Cram (1927) listed 15 species of *Tetrameres* from various birds, but none in the English sparrow. A related parasite, *Microtetrameres inermis*, was listed as having the sparrow as a definitive host, but as far as can be determined no other information on sparrow parasites in the nematode family Tetrameridae is available in the literature.

The roundworm genus *Tetrameres* is of both academic and economic interest. The nematode presents a striking sexual dimorphism in that the mature female loses its typical filiform shape after invading the glands of the proventriculus and assumes a globular appearance (Fig. 1). Also, unlike the male, the female becomes blood-red in color. It is during the invasion of the stomach

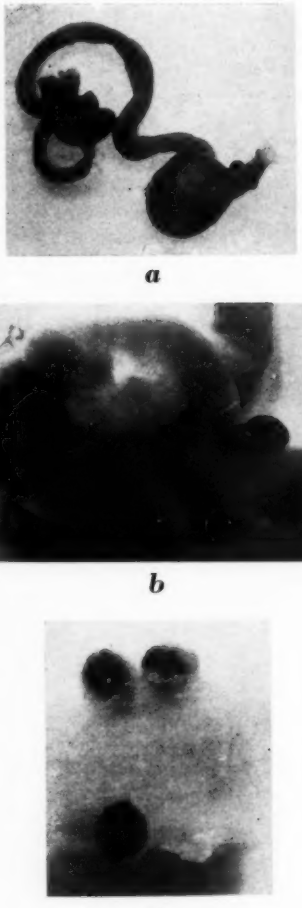

FIG. 1. Three females of *Tetrameres* sp. shown protruding from the outer proventricular wall of the English sparrow. *a*, Position of parasites in relation to gizzard and intestine; *b*, enlargement to show globular appearance of females; *c*, one female entirely free of the enveloping proventricular tissue, and other two partly imbedded.

[1]Federal Security Agency, U. S. Public Health Service, Helena Malaria Investigations Station, Helena, Arkansas. Manuscript received November 15, 1950.

[2]In a personal communication (1948), Dr. E. E. Wehr, U. S. Department of Agriculture, Bureau of Animal Industry, expressed the opinion that ". . . the specimens from the sparrow do not closely fit the description of any known species . . . ."

glands that the most severe clinical symptoms and even death of young birds may occur. Both males and females have been noted to feed on blood, and Cram (1931) pointed out that *T. americana* causes emaciation and droopiness in young chicks.

The primary objective of the present observations was to determine if the sparrow *Tetrameres* is infective to chickens. Additional biological data on this parasite have also been recorded.

MATERIALS AND METHODS

English sparrows were obtained by shooting them out of trees on the poultry farm at the University of Hawaii Agricultural Experiment Station. These birds were immediately dissected. Seasonal records on parasite incidence were thus obtained from February, 1947, to March, 1948. In some cases an examination of individual proventricular glands was made and the number of male and female parasites per gland was noted.

Adult female *Tetrameres* were removed from the proventriculus and macerated in a small dish in a drop of physiological saline. Bits of this material were fed to grasshoppers (*Oxya chinensis* and *Conocephalus saltator*). The individual hosts were subsequently dissected to check upon their experimental infections; no infected controls were found. The grasshoppers were maintained in a small screened cage and provided with various grasses from their natural habitat. Infected grasshoppers showing third stage (infective) larvae of the parasite were fed to young chicks by forcing the whole grasshopper into the crop with a long forceps.

DATA AND DISCUSSION

The seasonal incidence of *Tetrameres* sp. in the sparrow is shown in Table 1. These data indicate male and female infected hosts about equal in number and no apparent significant fluctuation in percentage of infection throughout the season. Nevertheless, the obvious conclusion is not justified since the age of the parasite and of the host is unknown, thus precluding any inferences on the rate of parasitic transfer from the intermediate to the definitive host. Cursory inspection indicated that the majority of female parasites were

TABLE 1

SEASONAL INCIDENCE OF *Tetrameres* SP. IN *Passer domesticus* FROM UNIVERSITY OF HAWAII AGRICULTURAL EXPERIMENT STATION

DATE	NO. BIRDS	NO. BIRDS INFECTED				NO. PROVENTRICULAR GLANDS INVADED		
		♀	♂	Total	%	Min.	Max.	Mean
2-8-47	12	3	1	4	33.3	1	10	3.3
3-1-47	11	2	2	4	36.3	1	2	1.5
4-3-47	20	5	4	9	45.0	1	3	1.8
6-5-47	12	1	1	2	16.6	1	2	1.5
7-8-47	15	1	2	3	20.0	1	2	1.5
9-10-47	19	3	1	4	21.0	1	4	2.0
10-20-47	20	1	4	5	25.0	1	10	4.2
11-14-47	18	3	4	7	38.8	1	6	1.9
12-14-47	25	4	4	8	32.0	1	4	1.5
1-16-48	20	4	2	6	30.0	1	9	3.0
2-10-48	15	2	3	5	33.3	1	6	2.0
3-21-48	20	7	3	10	50.0	1	8	2.1
Totals	207	36	31	67	22.2	1	10	2.1

TABLE 2

INCIDENCE OF *Tetrameres* SP. IN INDIVIDUAL GLANDS OF PROVENTRICULUS OF INFECTED SPARROWS

BIRD	NO. GLANDS INVADED	NO. ADULT		NO. ♂ PER GLAND			NO. ♂ IN PROVENTRICULAR LUMEN
		♀	♂	Min.	Max.	Mean	
1.	1	1	4	–	–	4.0	0
2.	10	10	18	0	4	1.8	8
3.	1	1	2	–	–	2.0	0
4.	1	1	2	–	–	2.0	0
5.	1	1	1	–	–	1.0	0
6.	2	2	1	0	1	0.5	3
7.	2	2	4	0	4	2.0	0
8.	1	1	0	–	–	0.0	1
9.	1	1	1	–	–	1.0	2
10.	1	1	4	–	–	4.0	0
11.	3	3	1	0	1	0.3	0
12.	3	3	3	0	2	1.0	0
13.	2	2	3	1	3	1.5	1
14.	2	2	1	0	1	0.5	2
15.	1	1	3	–	–	3.0	0
16.	1	1	1	–	–	1.0	2
17.	2	2	3	0	3	1.5	0
Totals ..	35	35	52	0	4	1.4	19

mature. Table 1 also presents some data on the number of proventricular glands invaded in the parasitized birds, the average number of invaded glands per bird being 2.1.

Individual parasitized proventricular glands were examined and it was found that no more than one female nematode per gland was the rule. The number of males varied from zero to four, with an average of about 1.4 per gland for all glands examined. Additional male worms were found in the proventricular lumen (Table 2). It should be noted that, unlike other *Tetrameres* species heretofore studied, the present form eventually reaches the outside stomach wall subsequent to its invasion of the gland from within the lumen. When a sparrow is first dissected, these globular, bright red female worms can be seen surrounded by the delicate intima of the outer stomach wall. They exert considerable pressure on this membrane, for a slight cut with a scalpel results in immediate expulsion of the female (see Fig. 1).

The mature female is nothing more than a sac of uterine coils filled with eggs, many of which are embryonated. These embryonated eggs have polar filaments about 12μ in length, and the eggs themselves are about 52μ long by 30 μ wide (Table 3).

Although the grasshoppers used here may not be the actual intermediate hosts in nature, the sparrow *Tetrameres* completed development in them. The parasite underwent two molts in these hosts—from the first to second, and second to third larval stages. The third larval stage was typically filariform and is presumed to be the infective stage for the vertebrate host. These third stage larvae were

TABLE 3

MEASUREMENTS IN MICRONS OF 25 EMBRYONATED EGGS OF *Tetrameres* SP. TAKEN FROM FEMALE UTERI

SIZE	MIN.	MAX.	MEAN
Length	50	55	52.2
Width	29	33	30.4
Length of polar filament	9	15	12.0

TABLE 4

DEVELOPMENT OF *Tetrameres* SP. IN *Oxya chinensis* AND *Conocephalus saltator*

LARVAL STAGE	NO. LARVAE MEASURED	LENGTH IN μ			WIDTH IN μ			MEAN LENGTH IN μ		
		Min.	Max.	Mean	Min.	Max.	Mean	Esophagus		Tail
1.....	18	196	375	266.6	16	32	21.0	126.4		48.3
2.....	5	388	555	473.6	28	37	33.0	170.4		70.8
3.....	7	740	891	830.1	40	45	42.0	pre-133.5	post-169.4	105.5

found loosely encysted along the dorsal body wall of the grasshopper in the oenocytes and very rarely in muscle tissue. By shaking these tissues in saline, the larvae could be easily removed. Infective larvae were observed in a minimum of 21 days after embryonated eggs had been fed to a grasshopper. Development took place equally well in both species of grasshoppers. Data on development of the larvae are given in Table 4.

Attempts to transmit the sparrow *Tetrameres* to young chicks proved negative in all of 11 trials. The age of the parasites in the grasshopper hosts varied from 45 to 60 days, and the period allowed for development in the chicks was from 30 to 75 days. The parasites in the grasshoppers were checked for larval stage and viability before they were fed to the chicks; thus it would appear that this parasite is probably not infective to young chicks.

SUMMARY

1. An apparently new species of *Tetrameres* has been found to parasitize English sparrows in Hawaii.
2. Adult male and female parasites were found invading the proventricular glands of sparrows throughout the year.
3. No more than one female per gland and from zero to four males with an average of 1.4 per gland were found in the proventriculus. This parasite, unlike other described *Tetrameres*, eventually protrudes from the outer stomach wall after invasion of a gland and growth within it.
4. The grasshoppers *Oxya chinensis* and *Conocephalus saltator* may serve as experimental intermediate hosts of the parasite, which reached the third larval stage in these hosts in a minimum of 21 days at room temperature.
5. Attempts to infect young chicks with third stage larvae of the sparrow *Tetrameres* failed in 11 trials.

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The Sponges of the Island of Hawaii[1]

M. W. DE LAUBENFELS[2]

THE ISLAND OF HAWAII lies farthest to the east and south of the chain of islands which comprise the Hawaiian archipelago. It has an area of more than 10,000 square kilometers. From it, capes project slightly north of 20° and south of 19° north latitude, also slightly west of 156° and east of 155° west longitude. Its two highest volcanic peaks, Mauna Kea and Mauna Loa, project respectively 4,201 and 4,170 meters above sea level. The whole island consists of four amalgamated volcanic cones, rising from an ocean floor which is about 5 kilometers deep; thus the unit rises more than 9 kilometers above its substrate. Only comparatively narrow regions of shallow water bound the island. In fact, along the steep north shore, there is practically no area which has a depth of less than 10 or 20 meters. The other shores, however, do have offshore regions less than 10 meters deep, and up to as much as 100 meters wide. The northeast side receives the trade winds, and therefore heavy rainfall; as a result a small river empties into the sea at Hilo. No other permanent streams occur on the island.

In the summer of 1945, Professor R. W. Hiatt of the University of Hawaii made an intensive study of an extremely arid and inaccessible region on the south shore of Hawaii, known as Halapé. His collection of sponges was turned over to me for study.

In May, 1948, a grant from the University of Hawaii enabled me to make a rather thorough collection about the shores of the island. There I was given the utmost assistance by the officials of the Territorial Board of Agriculture and Forestry; on the east side by Mr. Ernest Yap; and on the west side by Mr. Homer Hayes. I am also grateful to the President of the Territorial Board of Agriculture and Forestry, Mr. Colin Lennox, and to the Director of the Division of Fish and Game, Mr. Vernon Brock, for their assistance in the project.

Studies were made by using small boats, both row boats and motor-powered craft. The sea bottom was carefully observed by means of a glass-bottom "viewing box." Assistance in collecting was rendered by "skin divers," who swim down to a depth of a few meters.

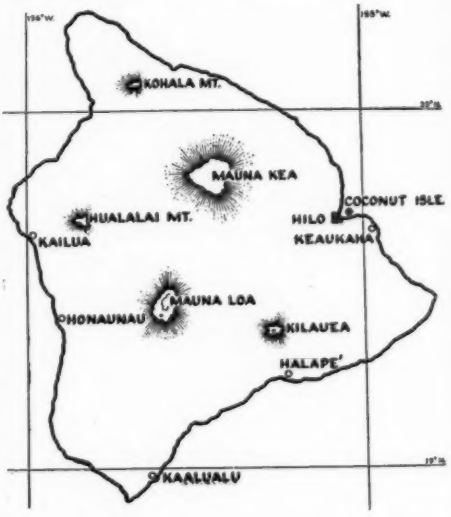

FIG. 1. The island of Hawaii, showing localities mentioned.

[1] Contribution No. 7, Hawaii Marine Laboratory. Manuscript received June 27, 1950.

[2] Formerly Professor of Zoology, University of Hawaii; now Professor of Zoology, Oregon State College, Corvallis, Oregon.

Some collecting was possible by wading, especially by turning over stones. No dredging was used in the present study.

Because of the scarcity of suitable environment, the number of species of shallow-water sponges around the island of Hawaii is only moderate. Twenty-eight kinds are recorded, of which nine are here described as new. Four of the others are peculiar to the Hawaiian Islands and thus only about half of the species are represented elsewhere.

The sponges of Kaneohe Bay, island of Oahu, in the central portion of the Hawaiian Islands, have recently been described (de Laubenfels, 1950: 3–36). The species which are there described are not here redescribed, but the page reference is given. All others are described because of the possibility that later studies may lead to the conclusion that some are new species, although here identified with previously described names. Many early descriptions are seriously incomplete, so that identification with them must be tentative. A key to genera is also included, as follows:

KEY TO GENERA

1. No proper spicules present 2
   Proper spicules present 3
2. Spongin network present . . . . . *Spongia*
   Spongin network absent . . . . . *Chondrosia*
3. Spicules of silica present 4
   Spicules of calcium carbonate present 27
4. Spicules only monaxon 5
   Triaxons or tetraxons also present . . . 23
5. No microscleres present 6
   Microscleres present 12
6. Spicules are tylostyles . . . . . *Terpios*
   Spicules are not tylostyles 7
7. Spicules are of several sorts . . . . *Rhaphisia*
   Spicules are all simple oxeas 8
8. Extensive subdermal spaces present . . . . . *Halichondria*
   Extensive subdermal spaces absent . . . 9
9. Spicules conspicuously protrude from the surface . . . . . *Phycopsis*
   Spicules do not conspicuously protrude from the surface 10
10. Dermal network present, with meshes much finer than those of the interior . . . . . *Callyspongia*
    No such dermal network present 11
11. Sponge in the form of definite tubes . . . . . *Reniera*
    Sponge not tubular . . . . . *Haliclona*
12. Microscleres are spirasters . . . . *Spirastrella*
    Microscleres not spirasters 13
13. Microscleres include spherasters . . . *Tethya*
    Microscleres do not include spherasters 14
14. Microscleres only smooth microxeas . . . . . *Petrosia*
    Other microscleres present 15
15. Microscleres only roughened raphides . . . . . *Tedamia*
    Other microscleres present 16
16. Microscleres only toxas . . . . . *Toxadocia*
    Other microscleres present 17
17. Microscleres only amphidiscs . . . . . *Hiattrochota*
    Other microscleres present 18
18. Megascleres include acanthostyles . . . . . *Microciona*
    Acanthostyles absent 19
19. Megascleres only strongyles . *Xytopsiphum*
    Other megascleres present 20
20. Megascleres tylotes and oxeas . *Damiriana*
    Megascleres monactinal 21
21. Microscleres do not include anisochelas . . . . . *Axocielita*
    Microscleres do include anisochelas . . 22
22. Microscleres include toxas . . . . . *Carmia*
    Microscleres do not include toxas . . . . . *Mycale*
23. Sterrasters present . . . . . *Geodia*
    Sterrasters absent 24
24. Aspidasters present . . . . . *Erylus*
    Aspidasters absent 25
25. Microscleres only euasters . . . . . *Myriastra*
    No astrose spicules present 26
26. Monoloph spicules present . . . . . *Plakina*
    Monoloph spicules absent . . . . . *Plakortis*
27. Numerous oxeas present . . . . . *Leuconia*
    Oxeas rare or absent . . . . . *Leucetta*

DESCRIPTIONS OF SPECIES

Spongia oceania de Laubenfels

Described in de Laubenfels (1950: 7).

This species appears to be common throughout the Hawaiian Islands. Hiatt found it at Halapé in 1945. I found it at Kaalualu and Honaunau, and, with the viewing box, observed numerous specimens (not collected), especially along the Kona coast from Honaunau to Kailua.

Haliclona permollis (Bowerbank) de Laubenfels
Fig. 2

This species is represented by U. S. National Museum, Register Number 22791 (Halapé No. I-106b), collected by Hiatt in August, 1945, at Halapé, on the undersides of rocks at the seaward edge of a rocky shore, depth less than 1 meter. I have found this species also on the island of Oahu.

This is a soft incrusting sponge, usually lavender in life. There is absolutely no dermal specialization of skeleton—the endosomal structures merely stop short. There are no extensive subdermal canals.

The skeleton comprises only one sort of spicule, an oxea 3 by 100 to 7 by 105μ. These are often arranged so as to outline polygonal meshes, each side just one spicule long. The spicules are joined to one another by spongin at the corners of these meshes. This structure is called isodictyal. In places there may also be tracts, almost fibers, of parallel rows of spicules held together by spongin.

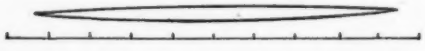

FIG. 2. *Haliclona permollis:* spicule, from a camera lucida drawing. (The scale shows 100 microns by tens.)

This species was first described as *Isodictya permollis* by Bowerbank (1866: 278) and transferred to *Haliclona* by de Laubenfels (1936: 40).

Reniera aquaeducta Schmidt
Fig. 3

This species is represented by U. S. National Museum, Register Number 22792 (My No. H. 79), collected May 15, 1948, at Keaukaha, at low tide, barely submerged. I found it again on May 16, 1948, at Kaalualu, and Hiatt took it in August, 1945, at Halapé.

This sponge consists of a number of tubes 20 to 25 mm. high, 3 to 9 mm. diameter, with walls 0.8 to 2 mm. thick. In life it was bluish violet and of spongy consistency. The surface is smooth.

The skeleton comprises only oxeas, 5 by 120 to 7 by 100μ. These are arranged much as in the preceding species.

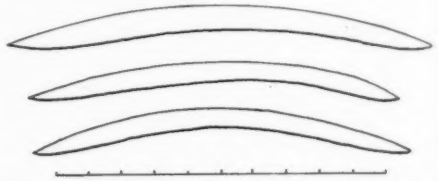

FIG. 3. *Reniera aquaeducta:* spicules, from camera lucida drawings. (The scale shows 100 microns by tens.)

This species was first described by Schmidt (1862: 72) from the Mediterranean as *Reniera aquaeductus*. It has since been recorded from various localities in both the North and South Atlantic, but this appears to be the first record for the Pacific Ocean. The species is probably cosmopolitan, but is nowhere abundant. An important discussion of it may be found in Burton (1930: 511).

Xytopsiphum meganese new species
Fig. 4

The type specimen of this species is U. S. National Museum, Register Number 22782 (My No. H. 83), collected May 16, 1948, at Kaalualu, at low tide, barely submerged.

This sponge is a paper-thin incrustation spreading laterally indefinitely. In life it was yellow-gray to ochre in color. There is a definite dermis with its contained spicules tangentially arranged.

The skeleton consists of strongyles, 3 by 210 to 3 by 240μ, and normally shaped arcuate chelas 16μ long.

The genus *Xytopsiphum* appears to be confined to the Hawaiian Islands; the type, *X. kaneohe* de Laubenfels, was described from Oahu by de Laubenfels (1950: 12). This Oahu species is characterized by slightly smaller megascleres (which is trivial) and by chelas radically different from those of the present species. The chelas of the former, while technically arcuate, are U-shaped with thick shafts and minute clads. The new species, *meganese*, is set off by having normal chelas with thin shafts and well-developed clads.

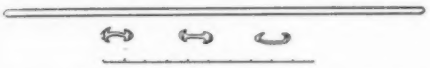

FIG. 4. *Xytopsiphum meganese:* spicules, from camera lucida drawings; one of the strongyles and three views of the arcuate chelas. (The scale shows 100 microns by tens.)

The name which is here selected is derived from the Greek words for "large" and "island," indicating that it is the species which is characteristic of the large island of Hawaii.

Callyspongia diffusa (Ridley) Burton

Described in de Laubenfels (1950: 12).

This species appears to be moderately common throughout the Hawaiian Islands. Hiatt found it at Halapé in 1945. I found it at Kaalualu in 1948.

Damiriana hawaiiana de Laubenfels

Described in de Laubenfels (1950: 14).

This species appears to be moderately common throughout the Hawaiian Islands. Hiatt found it at Halapé in 1945. I found it at Kailua in 1948.

Toxadocia violacea de Laubenfels

Described in de Laubenfels (1950: 14).

This species appears to be moderately common throughout the Hawaiian Islands. I found it not only on Oahu, but also near Hilo in 1948.

Petrosia puna new species

Fig. 5

The type specimen of this species is U. S. National Museum, Register Number 22780 (My No. H. 72; Halapé No. I-106), collected in August, 1945, by Hiatt at Halapé. It was said to be abundant on the undersides of stones at the seaward edge of a rocky shore at depths less than 1 meter.

This sponge is an incrustation, pale drab in life, of hard consistency. There is a tendency for its dermal spicules to be tangentially arranged. The endosome is densely packed with spicules and is only microcavernous. There is no localization of the different kinds of spicules.

The skeleton consists of megascleres of two size ranges. The larger type may be oxeas 13 by 166 μ, styles 14 by 132 μ, or strongyles 13 by 135 μ; each of the three occurs in approximately equal abundance. The size range of smaller spicules, almost as abundant as the larger, consists entirely of oxeas about 4 by 96 μ.

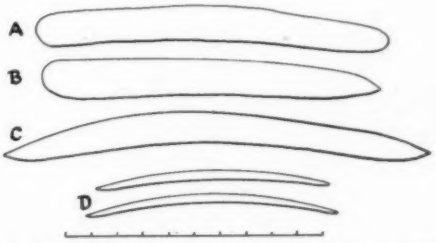

FIG. 5. *Petrosia puna:* spicules, from camera lucida drawings. A, Strongyle; B, style; C, oxea, larger size; D, two of the smaller oxeas. (The scale shows 100 microns by tens.)

This new species exhibits many points of difference from all others in the genus *Petrosia* except the genotype, which was first described as *Reniera dura* by Schmidt (1862: 77). This species, *dura*, is so far recorded only from the Mediterranean. From it the new

Hawaiian species differs as follows: The larger spicule category of *dura* is reported to comprise only oxeas and strongyles, whereas *puna* has, also, abundant styles. The smaller spicule category of *dura* comprises about equally abundant oxeas and strongyles; *puna* has only oxeas.

The specific name which is here selected is the Hawaiian name for the south coast of the island of Hawaii, the region where this species of *Petrosia* has been found.

Tedania ignis (Duchassaing and Michelotti) Verrill

Described in de Laubenfels (1950: 21).

This species appears to be quite common in the waters about the Hawaiian Islands. Hiatt found it at Halapé in 1945. I found it in 1948 near Hilo, also at Kaalualu, and near Honaunau.

Hiattrochota proteus de Laubenfels

Described in de Laubenfels (1950: 20).

This species is moderately common throughout the Hawaiian archipelago. In addition to the records on Oahu, I found it in 1948 at Kaalualu and at Honaunau.

Microciona maunaloa new species

Fig. 6

The type specimen of this species is U. S. National Museum, Register Number 22775 (My No. H. 74), collected May 14, 1948, near Hilo. This was obtained in Hilo Harbor near Coconut Island, at a depth of 2 meters, by diving.

This sponge is a paper-thin incrustation, spreading laterally indefinitely. In life it was a pale caramel-brown with definite pink tinges. In alcohol it turned blue. This reaction is unique and amazing. The consistency was soft.

In places where the whole sponge was only 400 μ thick there was an ectosomal region 150 μ thick. This was composed of a dermal membrane 10 μ thick, but otherwise almost no protoplasmic structures at all. Instead, it was full of tufts or bouquets of spicules, the heads at almost the same spot at the underlying surface of the endosome, the points all toward the outer surface but diverging at acute angles. The broad external expanse of each such bouquet is about 100 μ wide, the individual spicules about 150 μ long. The endosome is a rather dense mass of flesh, 250 μ thick, and, of course, permeated by canals and chambers. In it many spicules lie in confusion. Larger erect spicules pierce it, their heads on or near the substrate, their points toward the surface. The echinating spicules are confined to a thin region adjacent to the substrate.

The skeleton includes several size ranges of megascleres. The large spicules which protrude through the whole thickness of the incrustation are smooth tylostyles, upwards of 13 by 425 μ. Those scattered through the flesh are often about 9 by 240 μ. Those of the dermal tufts are about 6 by 160 μ, but some are only 6 by 120 μ. The echinating spicules are conspicuously spined acanthostyles about 8 by 42 μ. The microscleres include toxas 56 to 132 μ long and palmate isochelas 14 μ long; both types are quite commonplace in shape. In addition, however, there are abundant palmate isochelas of amazingly small size, only 5 to 6 μ long.

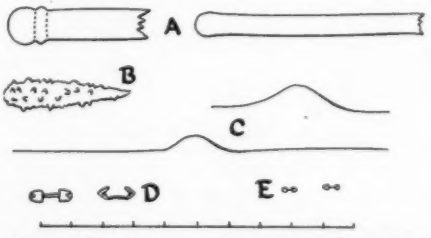

FIG. 6. *Microciona maunaloa:* spicules, from camera lucida drawings. A, Heads of tylostyles (the rest of these spicules is not shown); B, acanthostyle; C, two extremes of the toxa shape; D, larger palmate isochela; E, smaller isochelas. (The scale shows 100 microns by tens.)

This species is well characterized by its very small chelas. Several species in the genus

Eurypon have such microscleres, but not others in *Microciona*. The color is also unique; most species of *Microciona* are red. The extent to which the ectosomal spicules make symmetrical bouquets is also somewhat unusual in this very large genus.

The name which is here selected is that of the huge volcanic mountain Mauna Loa.

Mycale maunakea new species
Fig. 7

The type specimen of this species is U. S. National Museum, Register Number 22781 (My No. H. 75), collected May 14, 1948, in Hilo Harbor near Coconut Island at a depth of about 2 meters, by diving.

This sponge is incrusting, about 1 mm. thick. In life it was translucent, pale pink, and soft. It exhibited some recognizable oscules about 200 μ in diameter.

The ectosome is a transparent dermis, 50 to 75 μ thick, containing many microscleres but no megascleres. The endosome contains abundant spicular tracts which never anastomose and almost never branch. At the distal termination of each column, just under the dermis, the spicules of each tract diverge slightly, making dermal tufts which are much like miniature brooms. Such tufts are commonplace. These isolated non-reticulate tracts are 30 to 40 μ diameter and about 100 to 200 μ apart.

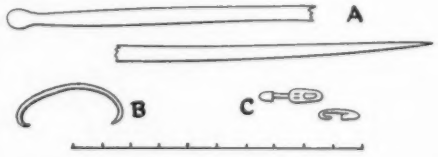

Fig. 7. *Mycale maunakea:* spicules, from camera lucida drawings. A, Tylostyle; B, sigma; C, palmate anisochelas. (The scale shows 100 microns by tens.)

The megascleres are smooth tylostyles 2 by 160 to 6 by 240 μ, often 5 by 210 μ. The microscleres include sigmas 37 to 42 μ in chord length and palmate anisochelas of peculiar shape. They are nearly isochelas, which is remarkable inasmuch as intermediates between isochelas and anisochelas are rare. They are very narrow with almost no lateral development on their convex side. Their lengths range from 13 to 22 μ.

Earlier (1950: 24) I identified a common sponge of Oahu as *Mycale cecilia*. It, too, is an incrusting sponge with narrow isochelas. But the microscleres in the Oahu sponge are quite commonplace in shape, and its tylostyles have unusually long heads, whereas the megascleres of the *Mycale* from the island of Hawaii are distinctive. At the moment it does not appear that any other species of *Mycale* has the utterly non-reticulate structure characteristic of the new species *maunakea*, and no other has chelas of the same peculiar shape. Those most nearly the same are found in *Mycale sulcata* Hentschel (1911: 307) (Australian and East Indian), but this species is digitate (not incrusting), has styles (not tylostyles), and has trichodragmas and two size ranges of chelas.

The name which is here selected is that of the extinct volcano Mauna Kea, which dominates the island of Hawaii.

Carmia contarenii (Martens) de Laubenfels
Fig. 8

This species is represented by U. S. National Museum, Register Number 22787 (My No. H. 84), collected May 16, 1948, at

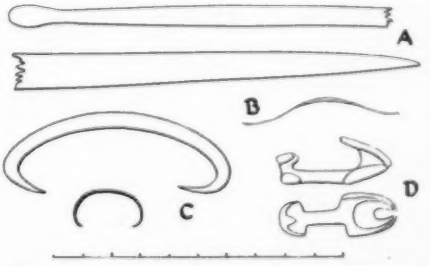

Fig. 8. *Carmia contarenii:* spicules, from camera lucida drawings. A, Tylostyle head and point, but the midportion is not shown; B, toxa; C, large and small sigmas; D, palmate anisochelas. (The scale shows 100 microns by tens.)

Kaalualu. It was found on the underside of a large stone barely submerged at low tide.

This sponge is incrusting, pale drab, and soft. The ectosome includes an optically evident reticulation of spicular tracts, as does the endosome. There are also many spicules which are merely strewn in confusion.

The megascleres are tylostyles with elongate heads, reaching a maximum of at least 13 by 350 μ, or 10 by 400 μ. The microscleres include sigmas 5 μ thick and 80 μ in chord length, smaller sigmas only 25 μ in chord length, toxas about 60 μ long, commonplace palmate anisochelas 40 μ long (which are often arranged in rosettes), and smaller palmate anisochelas only 10 μ long.

Martens in 1824 described *Spongia contarenii* from European waters. Topsent (1928: 78) redescribed it, placing it in *Mycale*. It was referred to *Carmia* by de Laubenfels (1936: 118). All records so far are from Europe, where it is common. The Hawaiian sponge which is here described is identified as *contarenii* only with grave doubts. It is so small a specimen and so devoid of striking characteristics, however, that it seems most unwise to erect a new species name for it. It exhibits no points of definite difference from *contarenii* and is at least closely related to the European species. Were more and better developed specimens available, grounds might be found for considering it a new species.

Axocielita kilauea new species
Fig. 9

The type specimen of this species is U. S. National Museum, Register Number 22779 (My No. H. 76), collected May 14, 1948, in Hilo Harbor near Coconut Island, at a depth of about 2 meters, by diving.

This sponge is incrusting and about 0.5 mm. thick. In life it was vermilion-red and of mediocre consistency. The surface is microhispid but lipostomous.

The ectosome does include a fleshy membrane, but it is rather vaguely developed. The whole sponge is so thin that it is also true that the endosomal structures lack conspicuous pattern.

The skeleton is composed of two types of megascleres. There are relatively large styles, often 12 by 280 μ, but sometimes at least 15 by 630 μ. Some are merely loose in the flesh, but others stand erect on the substrate, their points projecting slightly beyond the surface. The spicule heads that are in contact with the substrate are usually slightly spined. A second megasclere type is a smooth, straight tylostyle, about 2 by 144 μ in dimensions. These are often strewn in confusion but are more common at or near the surface than they are near the base of the sponge. The microscleres include commonplace toxas, 30 to 60 μ long, usually 50 μ. There are also peculiar chelas, perhaps of two sorts. Chelas of this type (or these types) are each about 14 μ long. Practically all of them reveal merely a C shape, but after long search one face-view of a palmate isochela of apparently commonplace form was found. When such chelas lie on their sides, they look somewhat like the above-mentioned C shape, but they are very likely to lie in such a position as to reveal the shape of their shovels; here they do not. Two explanations may exist to explain the peculiar situation in *Axocielita kilauea*. First, there may be such wide, peculiar lateral expansions on the shaft that equilibrium results from the side position. Second (and more likely), it may be that nearly all of these chelas have such exceedingly narrow shovels that they inevitably fall over on their sides.

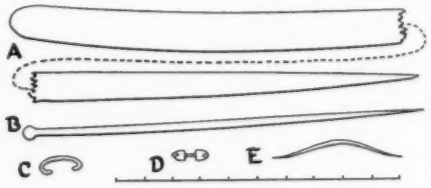

FIG. 9. *Axocielita kilauea:* spicules, from camera lucida drawings. A, Style; B, tylostyle; C, peculiar microsclere, probably in isochela, common in this species; D, the one typical palmate isochela; E, toxa. (The scale shows 100 microns by tens.)

The other species now in *Axocielita* have rather large, commonplace palmate isochelas. The species *kilauea* also exhibits minor differences in the sizes and shapes of its megascleres.

The specific name selected is that of the famous volcanic crater in the southern portion of the island of Hawaii.

Phycopsis aculeata (Wilson) de Laubenfels
Fig. 10

This species is represented by U. S. National Museum, Register Number 22784 (My No. H. 85), collected May 16, 1948, while wading, from a substrate of volcanic rock barely below low tide at Kaalualu.

This sponge is massive, the fragment collected being about 1 by 2 by 3 cm. The surface is strongly hispid and lipostomous. In life it was dark gray with an interior much paler than the exterior. The consistency was stiff and the sponge rather easily broken.

The ectosome, as delimited by darker color and somewhat denser structure, is about 2 mm. thick. The endosome is microcavernous, also dense.

The skeleton is composed of but a single sort of spicule. This is a smooth, sharply pointed oxea, 23 by 940 to 32 by 1,200 μ or more. The few megascleres that are smaller are doubtless developmental forms. These spicules are sometimes in confusion, but a significantly large proportion of them stand perpendicular to the surface, with about a third of their length protruding from it.

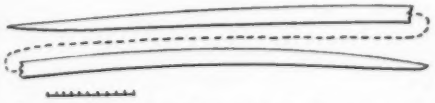

FIG. 10. *Phycopsis aculeata:* spicule, from a camera lucida drawing. (The scale shows 100 microns by tens.)

This species was first described as *Axinyssa aculeata* by Wilson (1925: 445), from the Philippines, and was transferred to *Phycopsis* by de Laubenfels (1936: 131).

Halichondria dura Lindgren
Fig. 11

This species is represented by U. S. National Museum, Register Number 22785 (My No. H. 73), collected May 14, 1948, from a depth of 2 meters in the harbor of Hilo, by diving.

This sponge is incrusting and reaches a thickness of about 3 mm. In life it was yellow and of a hard consistency. The surface is somewhat hispid and is lipostomous.

The ectosome is definitely set off as a layer perhaps 60 μ thick by the occurrence of extensive subdermal cavities which are 200 μ wide and 200 μ high. The endosome is of "crumb-of-bread" structure with abundant spicules in confused arrangement.

The skeleton consists chiefly of just one kind of spicule, an oxea. There is great variation in size. Very many of these spicules, however, are between 20 by 650 and 27 by 680 μ.

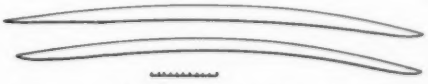

FIG. 11. *Halichondria dura:* spicules, from camera lucida drawings. (The scale shows 100 microns by tens.)

The identification of this specimen is made with some hesitation. The hispid surface is not typical of *Halichondria*, but some portions of *Halichondria* are slightly hispid, and the present specimen is only slightly hispid. The other items are all quite typical of *Halichondria*. Within this huge genus, the closest to the Hilo sponge is *dura*. This was described by Lindgren (1897: 480) from Java.

Rhaphisia myxa new species
Fig. 12

The type specimen of this species is U. S. National Museum, Register Number 22783 (My No. H. 82), collected May 16, 1948, at Kaalualu, by wading. It was just below low tide on a substrate of volcanic rock.

This sponge is incrusting and 1 to 2 mm.

thick. In life it was white; the consistency was extremely slimy but, at the same time, sticky or glue-like. The surface is smooth and lipostomous.

The ectosome is not sharply set off from the endosome. The latter is microcavernous with some vague tracts, about 100 to 125 μ apart and 20 μ in diameter, and containing 3 to 10 spicules per transverse section.

The skeleton, other than the ubiquitous colloidal stuff, consists of spicules which may be regarded as comprising only a single category but with much individual variation. Some are simple, smooth, sharply pointed oxeas 4 by 112 μ. Others, probably juvenile, are as small as 1 by 85 μ. Many are as large as from 5 by 117 to 6 by 150 μ, and the larger ones frequently have unusual shapes. It is common for them to be centrotylote, and some are also strongylote. Many, not centrotylote, have two distinct angular bends near the mid-point.

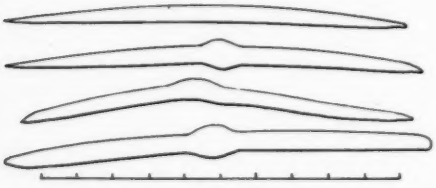

FIG. 12. *Rhaphisia myxa:* spicules, from camera lucida drawings. (The scale shows 100 microns by tens.)

All the sponges now in *Rhaphisia*, except the genotype, have much larger spicules than those of this new species. The genotype is *Rhaphisia laxa* Topsent (1892: xvii) from the Mediterranean region and is clearly the closest relative to the Hawaiian form. It also was viscous, but lacked the peculiar spicule shapes of *myxa*.

The species name here selected is derived from the Greek for slimy, and refers to the extreme development of a viscous colloid by this species.

Spirastrella keaukaha new species

Fig. 13

The type specimen of this species is U. S. National Museum, Register Number 22777 (My No. H. 78), collected at Keaukaha, May 15, 1948, far back from the surf on volcanic rock barely below low tide. This species was found also at Kaalualu and at Honaunau and is abundant all around Hawaii.

This is an incrusting species often as much as 3 mm. thick, spreading laterally indefinitely. In life it was orange-brown to red-brown, with a paler interior, but often with a very dark layer about 0.6 to 1 mm. below the surface—a layer about 50 to 120 μ thick. The consistency was rather like that of cheese. The surface is smooth and lipostomous, but subdermal canals (which doubtless terminated at oscules which close quickly and readily) are easily visible.

The ectosome is characterized by greater density and pigmentation than the microcavernous endosome. The microscleres are exceedingly abundant in the dermal layer.

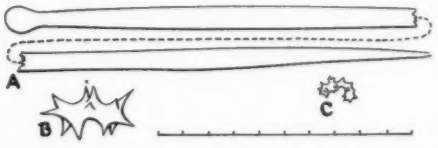

FIG. 13. *Spirastrella keaukaha:* spicules, from camera lucida drawings. A, Tylostyle; B, larger spiraster; C, smaller spiraster. (The scale shows 100 microns by tens.)

The skeleton is composed of tylostyles and spirasters. The former are smooth and straight, 8 by 328 μ, usually in confusion but oftenest with points directed toward the surface of the sponge. The microscleres are of two size ranges. The larger spirasters are about 40 μ long, the smaller about 16 μ long. Both kinds are astonishingly nearly straight, only slightly spiral. The smaller variety has spines which are more obtuse than might be expected.

There are now many names in the genus *Spirastrella*, and the opinion is here expressed that all the massive or ramose forms need to be removed to other genera, such as *Anthosigmella*. The remainder, all incrusting forms, are all much alike and require separation on slender margins of difference. It is here considered probable that there really are about six species in the world. This new species, *keaukaha*, is distinctive for the dark subdermal layer (not quite always present) and the almost straight axis of the spirasters.

The species name selected is that of the locality of the type specimen.

Terpios zeteki de Laubenfels

Described in de Laubenfels (1950: 28).

This species appears to be very common throughout the Hawaiian Islands. I found it to be abundant, not only on Oahu, but also at Kaalualu and at Honaunau in 1948.

Tethya diploderma Schmidt

Described in de Laubenfels (1950: 30).

This species appears to be abundant throughout the Hawaiian Islands. I found it to be so on Oahu and also found specimens at Kaalualu and Honaunau in 1948. Hiatt found it at Halapé in 1945.

Myriastra debilis Thiele

Fig. 14

This species is represented by U. S. National Museum, Register Number 22789 (My No. H. 71), collected in August, 1945, by R. W. Hiatt at Halapé. It was growing on dead coral in the surf area.

This species is massive, reaching a thickness of at least 1 cm. In life it was pale and the consistency was cartilaginous. The surface is partly smooth and partly hispid, and the Hawaiian specimens appear lipostomous.

The ectosome is vaguely corticate, the endosome is semi-radiate. Presumably all well-developed specimens will be definitely corticate and of radiate architecture with the spicules all more or less perpendicular to a spherical surface.

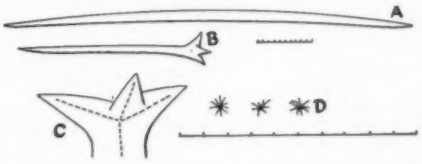

Fig. 14. *Myriastra debilis:* spicules, from camera lucida drawings. A, Oxea; B, plagiotriaene; C, head or cladome of a plagiotriaene; D, three oxyeuasters. (The smaller scale matches A and B, showing 100 microns by tens. The larger scale matches the more highly magnified C and D, showing 100 microns by tens.)

The skeleton consists of very numerous spicules, often in confusion, but many are perpendicular to the surface. There are smooth, sharply pointed oxeas 18 by 720 μ. There are plagiotriaenes with rhabds 16 by 320 μ and very short clads; the latter are often less than 32 μ long. Some broken bits of long thin spicules, only 2 or 3 μ in diameter, are here interpreted as being fragments of the rhabds of anatriaenes whose cladomes (not found) formerly protruded from the surface but have been broken off. The microscleres are oxyeuasters about 10 μ in diameter. They are astonishingly rare.

Thiele (1900: 25) described *Myriastra debilis* from the East Indies. He did find the anatriaenes, but their absence from the Hawaiian specimen does not necessarily mean that it is not the same species. Thiele's specimens agreed with ours in lacking the protriaenes and in having similar short-clad plagiotriaenes and microscleres.

Geodia gibberella new species

Fig. 15

The type specimen of this species is U. S. National Museum, Register Number 22778 (My No. H. 66), collected in August, 1945, by R. W. Hiatt at Halapé. It was found at a depth of 3 meters on a coral "head" in the channel between the steep shore and a small off-shore island. This species seems to be uncommon in the Hawaiian Islands.

This sponge is massive to subglobular and is over 1 cm. in diameter. Its color is dirty gray. The surface consistency is hard, almost stony (due to the sterraster armor), but somewhat flexible. The interior is softer and more compressible. The surface is smooth and lipostomous.

The ectosome is a fibrous cortex nearly 1 mm. thick and is densely packed with sterrasters. The endosome shows a fundamental tendency to radiate architecture but realizes this structure only vaguely.

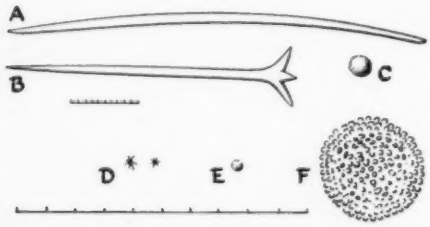

FIG. 15. *Geodia gibberella:* spicules, from camera lucida drawings. A, Oxea; B, plagiotriaene; C, sterrasters; D, oxyeuasters; E, spheraster; F, sterraster. (The smaller scale for A, B, and C shows 100 microns by tens. The larger scale matches the more highly magnified D, E, and F and shows 100 microns by tens.)

The megascleres are sharp-pointed oxeas 15 by 620 μ and plagiotriaenes with rhabds 18 by 410 μ and clads 60 μ long. The microscleres include the large sterrasters which are characteristic of *Geodia*, but not as large as they are in most of the species of this genus; they have a diameter of only about 37 μ and are nearly spherical. The mature sterrasters are practically all in the cortex, but their sharp-rayed juvenile forms, as usual, occur sparingly in the endosome. Additional microscleres of two sorts also occur—oxyeuasters 6 μ in diameter and oxyspheraster only 5 μ in diameter. The euasters are abundantly present in a thin layer over the outer surface of the sterraster armor.

Lamarck (1815: 333) described *Geodia gibberosa*, the type of the genus. It is an abundant West Indian species, not certainly recorded from any other locality. It and this Hawaiian species stand out from the rest of the genus for lack of anatriaenes and protriaenes and for the possession of minute spherasters. Clearly *gibberosa* is the nearest relative to *gibberella*. But the West Indian *Geodia* has large (30 μ) oxyeuasters.

The species name which is here selected is a diminutive of *gibberosa*.

Erylus proximus Dendy

Fig. 16

This species is represented by U. S. National Museum, Register Number 22786 (My No. H. 57), collected February 19, 1948, by dredging at a depth of 50 meters in the open ocean 2.5 kilometers south of Pearl Harbor, Oahu. This species is not common, but is widely distributed in the Hawaiian archipelago. Hiatt collected it (his No. I-38a G) in August, 1945, at Halapé.

This is an amorphous sponge, often growing in interstices of dead coral or cracks in rocks. In life the ectosome was dark gray to black, the endosome a paler gray or drab. The consistency was cartilaginous. The surface is microtuberculate. The pores are about 70 μ in diameter and 300 to 400 μ apart. The rare oscules are about 1.5 mm. in diameter.

The ectosome is a fibrous cortex densely

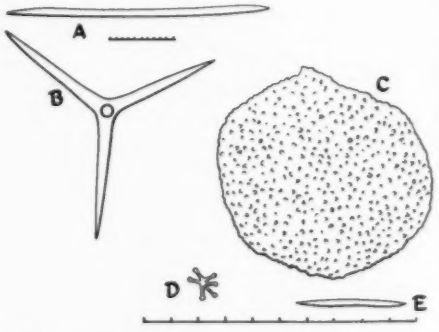

FIG. 16. *Erylus proximus:* spicules, from camera lucida drawings. A, Oxea; B, tetraxon; C, aspidaster; D, tylaster; E, microxea. (The smaller scale for A and B shows 100 microns by tens. The larger scale matches the more highly magnified C, D, and E and shows 100 microns by tens.)

packed with aspidasters and is about 100 μ thick. The endosome is microcavernous and confused.

The skeleton includes oxeas 8 by 500 to 12 by 420 μ and tetraxons that might almost or quite suitably be called calthrops. Their nearly equal rays are 5 by 105 to 15 by 200 μ; one is often slightly longer than the others and might be considered a rhabd but is not clearly so. In addition to these definite megascleres, there are oxeas 3 by 50 μ, perhaps also megascleres, but probably to be regarded as microscleres. There are abundant aspidasters in the cortex. These microscleres are less than 10 μ thick, but are 80 μ in diameter—irregularly rounded discs. They are densely covered with conical projections, probably homologous with the rays of asters, but also resembling the spines on acanthoscleres. Finally, eutylasters 15 μ in diameter are also present.

This species was described by Dendy (1916: 258) from the Indian Ocean, the only previous record. The agreement with Hawaiian specimens is amazingly close.

Plakortis simplex *Schulze*

Described in de Laubenfels (1950: 33).

This species appears to be moderately common throughout the Hawaiian Islands. I found it at Keaukaha in 1948.

Plakina monolopha Schulze

Fig. 17

This species is represented by U. S. National Museum, Register Number 22788 (My No. H. 87), collected May 17, 1948, at Honaunau at a depth of about 1 meter.

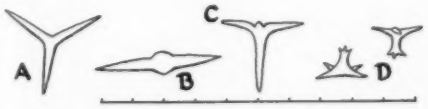

Fig. 17. *Plakina monolopha:* spicules, from camera lucida drawings. A, Triaxon; B, centrotylote oxea; C, tetraxon; D, monoloph spicules. (The scale shows 100 microns by tens.)

This is a thin crust 0.6 to 0.8 mm. thick, drab, soft, and lipostomous. There is little ectosomal specialization. The endosome is densely fleshy, with canals 100 μ in diameter perpendicular to the surface and 200 to 500 μ apart. Doubtless in life these ascended to minute oscules.

The commonest spicules are regular triaxons, with rays 3 by 20 to 4 by 24 μ. There are sagittal tetraxons with two clads about this same size, the third clad very small, and the rhabd slightly longer. There are oxeas, about 4 by 36 μ, usually centrotylote. Finally, there are the distinctive monoloph calthrops; these tetractinellid or pentactinellid spicules have three or four simple sharp smooth rays, about 3 by 12 μ, in one plane, as divergent from each other as possible. The odd ray is at right angles to them and about as long but terminates in about four sharp spines.

This species was first described by Schulze (1880: 407) from the Mediterranean. It has since been recorded from various European regions and by Thiele (1898: 28) from Japan. It is doubtless cosmopolitan, but neither really abundant anywhere nor ever conspicuous.

Chondrosia chucalla de Laubenfels

This species is represented by U. S. National Museum, Register Number 22790 (My No. H. 77). It was collected at Halapé in 1945 by R. W. Hiatt (His No. II 679). This was from lava rock in a tide pool at the west end of Keaoi Island, at low tide. It was common in this vicinity.

This is a massive, subspherical sponge. The Hawaiian specimens are about 1 cm. thick and 3 by 6 cm. in lateral dimensions. The color is black as to surface, dark drab as to interior. The surface is smooth, shining, and slimy. The pores are all closed, but oscules, each about 1 mm. in diameter, can be discovered in groups of 2 or 3, such groups about 1 cm. apart.

The skeleton of all sponges probably includes a greater or lesser amount of non-

living colloidal material. In this species (and genus) there is a relatively large quantity of this, and here it is in a fairly stiff gel condition. The ordinary methods of search reveal no inorganic skeleton—that is to say, no spicules at all. Exceedingly rare spicules may be present, but this is surmise.

This species was first described as *Chondrosia collectrix* by Lendenfeld (1888: 74) from Australia, its only previous locality record. There was already a different *Chondrosia collectrix*, that of Schmidt (1870: 25). Therefore de Laubenfels (1936: 184) set up the new name *chucalla* for Lendenfeld's species.

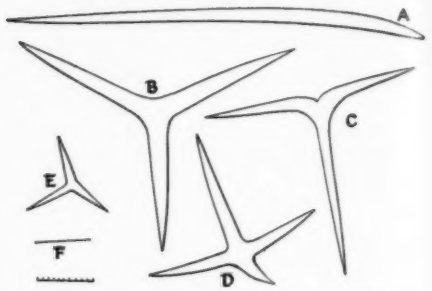

FIG. 18. *Leuconia kaiana:* spicules, from camera lucida drawings. A, Oxea; B, regular triaxon of the chamber layer; C, sagittal triaxon, from subdermal area, and oscular region; D, tetraxon from lining of cloaca—the curved ray projects into the cloaca; E, smaller triaxon; F, microxea. (The scale shows 100 microns by tens.)

Leuconia kaiana new species

Fig. 18

The type specimen of this species is U. S. National Museum, Register Number 22776 (My No. H. 86). This was collected in August, 1945, by R. W. Hiatt (His No. III 870) at Halapé. This species was found abundantly on coral about 2 meters deep on the outer, surf-pounded slope of the small island of Keaoi. This, or a similar *Leuconia*, is widespread in the Hawaiian region. I have found it also at Pearl Harbor, Oahu.

This species is hollow—that is to say, it possesses a relatively large cloaca. The shape is very roughly cylindrical, larger in the middle than at the ends, but the cylindrical shape is further modified by the occurrence of small, short branches. A total height of at least 3 cm. is reached and a diameter of 8 mm.; the walls are almost 1 to 2 mm. thick. The cloaca penetrates nearly the entire length of the sponge.

The color is whitish and the consistency fragile. The surface is hispid, but there is no coronal fringe around the oscules. The latter are about 2 mm. in diameter.

The ectosome contains many tangent rays of polyactinal spicules. The endosome has an architecture perhaps to be termed rhagon, but almost that which has been termed sylleibid. In the latter, the flagellate chambers are concentrated in clusters, but the clusters are rather distinct from each other.

The skeleton includes oxeas 25 by 750 μ, perpendicular to the surface, and partially protruding so that they render it hispid. The spicules of the chamber layer are chiefly regular triaxons with rays about 35 by 300 μ. Many sagittal triaxons with their clads near the surface and parallel to it also occur. The clads are about 20 by 200 μ; the rhabds penetrate the chamber layer perpendicular to the surface and are about 20 by 300 μ. Many tetraxons line the cloaca, two medium-sized rays tangentially placed in its lining, a small bent ray protruding into the cloaca, and a longer ray piercing the chamber layer, perpendicular to the cloacal surface. The latter ray is about 25 by 225 μ; the paired rays are about 25 by 175 μ in dimensions. Many small, regular triaxons are present, especially near the inner and outer surfaces. Their rays are about 10 by 100 μ. Microxeas also occur, only 1 by 90 μ.

The species is probably closest to that *Leuconia* which was first described as *Leucandra taylori* by Lambe (1900: 261) from Vancouver Island, British Columbia. The smaller triaxons of Lambe's species had rounded (strongylote) ends, and it did have a coronal fringe around the oscules. Both *taylori* and *kaiana* seem related to the com-

mon species of the genus *Rhabdodermella* of the American Pacific coast.

The species name which is here selected is that of the famous ancient Hawaiian nobleman, Prince Kaiana.

Leucetta solida (Schmidt) Dendy and Row

Described in de Laubenfels (1950: 34).

This species appears to be moderately common about the Hawaiian Islands. I found it on Oahu, and R. W. Hiatt found it at Halapé in August, 1945.

ECOLOGICAL OBSERVATIONS

My first study was made in Hilo Harbor, near Coconut Island. The representative of the Territorial Board of Agriculture and Forestry who accompanied me was a capable diver and brought up much material for examination from depths of about 2 meters. The location, although on the windward side of the island, is sheltered from the full force of the sea. No sponges were common in this area, nor were any found to be large. On the other hand, the fauna here was unique. Five species were found—three were new, one (*Halichondria*) perhaps new although tentatively identified, and another has been reported from only one other locality (Oahu, also in the Hawaiian Islands). The species are:

Halichondria dura (?): also East Indies (?).
Toxadocia violacea: also Oahu.
Mycale maunakea: new.
Axocielita kilauea: new.
Microciona maunaloa: new.

My second study was made at Keaukaha, near Hilo on the windward coast but a location which was much more exposed to the force of the ocean than was the one at Hilo. Only a few years previously (1946) this coast had been devastated by a huge tsunami (a so-called "tidal wave"). Here the collecting was done by wading at low tide. Four species of sponge were found: three are certainly world-wide and the fourth (*Spirastrella*) is possibly also world-wide although here it is tentatively identified as a new species. These species are:

Tedania ignis: also Oahu, Kaalualu, Halapé, West Indies, etc.
Reniera aquaeducta: also Halapé; circumequatorial.
Plakortis simplex: also Oahu; circumequatorial.
Spirastrella kaukaha: new (?); also Kaalualu and Honaunau. Closely related species are equatorial.

My third study was made at Kaalualu, near the extreme southern point of the Hawaiian Islands. Here again we collected by wading at low tide. I found the greatest variety of sponges here of any place studied on the island of Hawaii—10 species in all. They are:

Callyspongia diffusa: also Oahu, Indian Ocean, East Indies.
Xytopsiphum meganese: new.
Tedania ignis: also Keaukaha, Halapé, Oahu, West Indies, etc.
Carmia contarenii: also European, etc.
Hiattrochota proteus: also Oahu and Honaunau.
Phycopsis aculeata: also Philippines.
Rhaphisia myxa: new.
Spirastrella keaukaha: also Keaukaha and Honaunau.
Terpios zeteki: also Oahu, Halapé, Honaunau, and Panama.
Tethya diploderma: also Oahu, Halapé, Honaunau, and circumequatorial.

My fourth study was made at Honaunau, on the sheltered lee coast (Kona Coast) on the west side of the island. Here collections were made with the help of representatives of the Territorial Board of Agriculture and Forestry, who dove down to depths of 2 meters to collect specimens.

After collections at Honaunau, studies were made along the Kona Coast as far north as Kailua, but by so doing we were able to locate just one additional species (*Damiriana hawaiiana*).

It should be observed that, of any of the places studied on the larger island, the sponge fauna of the Kona Coast of Hawaii is the most like that of the island of Oahu. Seven species were found, of which five have already been reported from Oahu, and I strongly suspect that the two additional species also occur on Oahu. The species are:

Spongia oceania: also Oahu and Halapé.
Hiattrochota proteus: also Oahu and Kaalualu.
Damiriana hawaiiana: also Oahu.
Spirastrella keaukaha: also Keaukaha and Kaalualu.
Tethya diploderma: also Oahu, Kaalualu, Halapé; circumequatorial.
Terpios zeteki: also Oahu, Kaalualu, and Panama.
Plakina monolopha: also Mediterranean, Japan, etc.

As already noted, R. W. Hiatt made a most interesting ecological study in August, 1945, at Halapé. This is somewhat farther north and east than Kaalualu. The study was made along a stretch of coast so nearly inaccessible that it was probably in a natural state and not disturbed by human meddling. The region may be analyzed into three subdivisions as follows:

1. The shore of the large island. There were steep cliffs of lava, boulders at the water's edge, one small patch of sand, and some tide pools.
2. A shallow, protected area inside the lee of a small island. The depth was about 4 meters, with scattered coral heads. A current of about 2 to 3 kilometers per hour set through this area, running parallel to the coast.
3. A small island called Keaoi—a sort of pahoehoe blister with some tide pools. The outer edge of this island was pounded by surf.

Sponges were recorded as follows:

1. Under rocks, just below tidemark
   Halichondria permollis: world-wide.
   Reniera aquaeducta: world-wide.
   Petrosia puna: new, rare.
   Tethya diploderma: world-wide, common.
   Geodia gibberella: new, uncommon.
2. Collected by diving
   Spongia oceania: local, common.
   Tedania ignis: wide distribution, common.
   Tethya diploderma: world-wide, common.
   Geodia gibberella: local, not common.
3. In various locations on Keaoi islet
   Spongia oceania: local. This was found on a shelf in a cove, also deep on the exposed outer edge.
   Damiriana hawaiiana: local, rare.
   Tedania ignis: wide distribution, abundant in a variety of locations.
   Myriastra debilis: also East Indies. This occurred where it received the full force of the surf. On the mainland I have found species of *Myriastra* similarly placed.
   Chondrosia chucalla: also Australian. This was common in some tide pools on the islet.
   Leuconia kaiana: new. This was common, in deep water on the exposed outer edge.
   Leucetta solida: world-wide. This genus often occurs in these exposed situations.

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The Scientific Name of the Nehu, an Engraulid Baitfish of the Hawaiian Islands[1]

WILLIAM A. GOSLINE[2]

The nehu, a small baitfish commonly used for tuna fishing in Hawaiian waters, was originally described as *Stolephorus purpureus* in 1900 by Fowler (1900, *Acad. Nat. Sci. Phila., Proc.*, p. 497). Since that time it has been variously assigned to the genera *Stolephorus*, *Anchovia*, *Anchoviella*, *Engraulis*, and *Scutengraulis*, and no agreement has been reached. Though future revision of the anchovies on a world-wide basis may show that the nehu belongs elsewhere, under the present classification of the group it may best be allocated to the genus in which it was placed originally as *Stolephorus purpureus*.

Of the five genera to which the nehu has been assigned, *Stolephorus*, *Anchoviella*, and *Engraulis* deserve most serious consideration. Jordan and Seale in their now outdated "Review of the Engraulidae" (1926, *Mus. Comp. Zool., Bul.* 67: 403) place the nehu in the genus *Anchoviella*. Hardenberg (1933, *Natuurk. Tijdschr. Neder.-Indie* 93: 242) believes that the three genera *Engraulis*, *Anchoviella*, and *Stolephorus* as defined by Jordan and Seale cannot be maintained and should be combined under the oldest generic name, *Stolephorus*. Hildebrand (1943, *Bingham Ocean. Coll., Bul.* 8(2): 108) resurrects the generic name *Anchoviella* for some American anchovies, but on a different basis from *Anchoviella* of Jordan and Seale. Hildebrand fails to state how his *Anchoviella* differs from *Stolephorus*, and a comparison between the American *Anchoviella* as defined by Hildebrand and the Indo-West-Pacific *Stolephorus* remains to be made. Nevertheless, since *Stolephorus* is the older of the two generic names and since the Hawaiian Islands have a basically Indo-West Pacific fauna, it seems safe to conclude that the nehu belongs with *Stolephorus* rather than with *Anchoviella*.

Both Hildebrand (*op. cit.*) and Blackburn (1950, *Austral. Jour. Mar. Freshwater Res.* 1(1): 5) likewise resurrect *Engraulis* from Hardenberg's synonymy of *Stolephorus*. The nehu does not belong in *Engraulis* as defined by these authors and thus, by elimination, remains with *Stolephorus*.

Two other problems of nehu nomenclature, though long since solved, continue to haunt ichthyological literature. One is the application of the name *Stolephorus* itself. Lacépède, who proposed the name, included under it species of two different families and designated no genotype. The question therefore arose as to which genus of which family the name *Stolephorus* should be applied. This matter was eventually resolved by the International Commission on Zoological Nomenclature, which (Opinion 93) designated *Stolephorus commersonianus*, a fish of the nehu group, as genotype of *Stolephorus*. Unfortunately, Fowler, Whitley, and Blackburn continue to apply the name *Stolephorus* erroneously to a genus of herring-like fishes.

Finally, *Anchoviella mauii* was described by Fowler and Bean (1924, *U. S. Natl. Mus., Proc.* 63(19): 4) as new and as from Maui. However, Fowler has since pointed out (1934, *Bernice P. Bishop Mus., Mem.* 11(6): 387) that the species is not new and that the Maui record is not correct. The nehu, *Stolephorus purpureus*, thus remains the only anchovy recorded from the Hawaiian Islands.

I am particularly indebted to Prof. C. L. Hubbs of the Scripps Institution of Oceanography and Prof. G. S. Myers of Stanford University for their advice on this matter.

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Manuscript received November 29, 1950.

Records and Descriptions of Some Micronesian Psyllidae (Homoptera)[1]

LEONARD D. TUTHILL[2]

DR. TEISO ESAKI of Kyushu University, Fukuoka, Japan, has very kindly placed at my disposal the collections of Psyllidae made during his expeditions to the islands of Micronesia during the years 1936 to 1940. Only a few collections have been made in this area and undoubtedly many more members of this family remain to be discovered there. A few species which are widespread throughout the Pacific are represented in the material included. The remainder appear to be unnamed and probably represent forms endemic to the island or group from which they were taken. All specimens bear the collector's label of Teiso Esaki except where otherwise indicated.

The figures have been prepared by Evan L. Gillespie of the Department of Zoology and Entomology, University of Hawaii.

Mesohomotoma hibisci (Froggatt)

Marianna Islands: Charanka, Saipan, October 31, 1937.

Caroline Islands: Paliker-Kolonia, Ponape, December 30, 1937, January 16, 1938, and July 16, 1939; Nipit-Kapiroi-Reitao, Ponape, July 21, 1939; Lelo, Kusaie, November 30, 1937.

This species is common on the young foliage of *Hibiscus tiliaceus* L. throughout most of the Pacific islands. Esaki notes that it is gregarious and that *Arbela hibisci* Esaki and Ishihara, a nabid bug, is found in association with it.

Tyora ornata (Kirkaldy)

Caroline Islands: Kolonia, Ponape, December 31, 1937; Toloas, Kutua, Truk, July 31, 1939.

A single male, without additional data, was taken in each of these collections.

Leptynoptera sulfurea Crawford

Caroline Islands: Kolonia-Jokaji, Ponape, January 9, 1938; Paliker-Kolonia, Ponape, January 16, 1938; Kolonia, Ponape, January 17, 1938; Gatzapar, Yap, September 1, 1939.

Palau Islands: Akarokuru, Peliliou, August 12, 1939; Kaishar-Ngardok-Ngiwal, Babeldaob, August 15, 1939.

Esaki reports this species as common in Palau, Yap, and Ponape, feeding on young leaves of *Calophyllum Inophyllum* L., gregariously.

Arytaina clara (Tuthill)

Ataenia clara Tuthill, Bernice P. Bishop Mus., Occas. Papers 17: 77, 1942.

Caroline Islands: Kolonia, Ponape, December 31, 1937, and January 1, 1938.

One male and one female constitute the entire collection of this species, which is only known to occur on Ponape. The host plant is unknown.

This and the following related species belong to a large group of species known from the Orient which were assigned to *Arytaina* by Crawford. They are certainly quite far removed from the type species of *Arytaina*, being much nearer *Euphalerus*. I am informed by G. Heslop-Harrison that he is presently revising the many-faceted group that *Arytaina* has become. In the course of such

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[1]Results of Professor T. Esaki's Micronesian Expeditions, 1936–1940, No. 78. Manuscript received June 28, 1950.

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revision he will undoubtedly erect a new genus for this group of species.

Arytaina extrema n. sp.

Fig. 1

Length to tip of folded wings, 3.0–3.25 mm.

Color: Dried specimens uniformly brown. When alive probably green, at least abdomen.

Structure: Short pubescence general on body. Head broader than thorax, strongly deflexed. Vertex flat, strongly narrowed anteriorly, blunt protuberance next each eye. Genal processes much below plane of vertex, broad, blunt, one-third as long as vertex, with ring of large stiff setae. Antennae slender, three times as long as width of head. Thorax broad, quite flat. Pronotum large, vertical anteriorly. Forewings broad, slightly over twice as long as wide, broadly rounded apically; venation typical, Cu_1 very strongly arched; pterostigma large, prominent. Legs stout. Metatibiae with large, curved basal spine and 5 black apical spines, 2 single and a cluster of 3.

Male genital segment large, with short pubescence. Proctiger in lateral view slender, produced caudad apically. Forceps about as long as proctiger, slender basally, enlarged apically and produced both caudad and cephalad as figured, inner surface beset with numerous short heavy setae. Female genital segment large, slender; dorsal valve elongate, sinuate, abruptly turned up at apex, with area of minute spines laterally in addition to usual setae; ventral valve long, upturned, acute.

Holotype male, allotype female, and 26 paratypes collected at several localities (Matansha-Calabera, Garapan, Garapan-Sadog Tasi, Tapôcho, Fanagam) on Saipan, Marianna Islands, May 2–6, 1940, Yasu. et Yoshi. Type in author's collection.

This species is very evidently related to *A. clara* (Tuthill) but is readily distinguished by the shorter genal processes, which are much more depressed below the plane of the vertex, the shorter antennae, and details of the genitalia, especially those of the male.

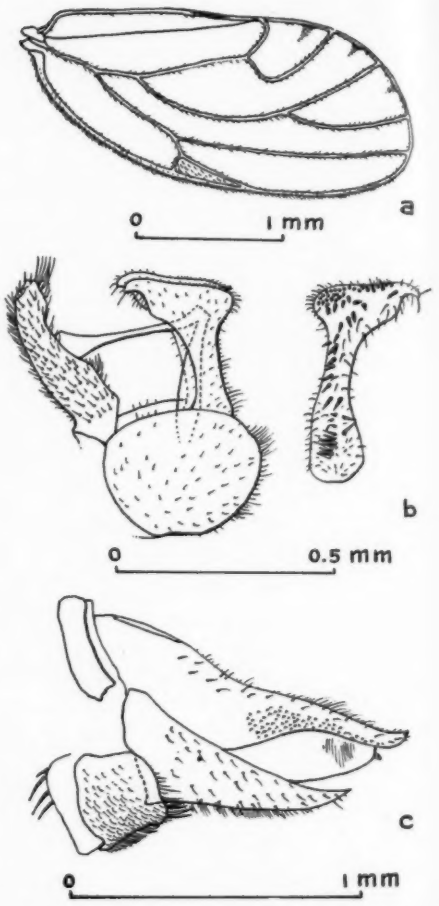

FIG. 1. *Arytaina extrema* n. sp. *a*, forewing; *b*, lateral aspect of male cauda and inner face of clasper; *c*, lateral aspect of female cauda.

Trioza (Megatrioza) vitiensis Kirkaldy

Caroline Islands: Kolonia-Jokaji, Ponape, January 9, 1938; Matalanim, Ponape, January 11, 1938; Matalanim-Nipit, January 12, 1938; Kolonia-Paliker, July 16, 1939.

Esaki notes this widespread species as common on Ponape, where it forms very con-

spicuous round galls, about the size of a pea, on the leaves of *Eugenia malaccensis* L. It was probably introduced with its host tree.

Trioza suavis n. sp.

Fig. 2

Length to tip of folded wings, 3.5–4 mm.

Color: General color green. Antennae, legs, and margins of thoracic tergites tan. Wings hyaline.

Structure: Head slightly wider than thorax. Vertex short, rounded down both cephalad and caudad, medial suture prominent, posterior ocelli on lateral surface of large protuberances. Eyes large, hemispherical. Genae produced as short, blunt processes, 0.5 as long as width across vertex between eyes. Antennae long and slender, 3.7 times as long as width of head, segment III as long as width of head. Thorax strongly arched. Pronotum vertical. Forewings large, acute apically, 2.6 times as long as wide; Rs short, arched to costa; marginal cells large, medial larger than cubital. Hind wings relatively small but extending well beyond tip of abdomen. Legs stout. Metatibiae with small basal spur, 1 outer and 3 inner large apical spines. Mesopleura and sternum strongly produced. Metacoxae normal.

Male genital segment large. Proctiger strongly produced caudad as figured. Forceps a little shorter than proctiger; in lateral view straight to blunt apex; in caudal view arched to acute black apices; seen dorsally apices notched forming 2 black teeth. Female genital segment small, structure as figured.

Holotype male, allotype female, Palau Islands: Ngardok-Ngarmisukan, Babeldaob, February 11, 1938. Paratypes, 1 male same data as holotype; 2 females, Eimilik-Ngarmisukan, Babeldaob, August 18, 1939; 1 female, Ngarmisukan-Kaishar, Babeldaob, August 14, 1939. Type in author's collection.

Esaki reports this species as forming galls on the leaves of *Ficus* sp. It resembles some of the species assigned to *Megatrioza* by Crawford, especially in the conformation of

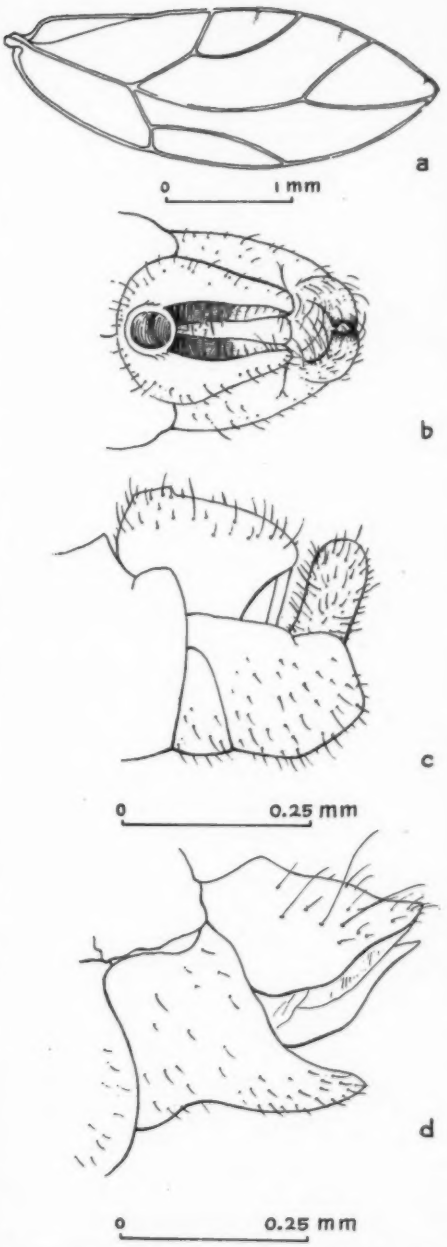

FIG. 2. *Trioza suavis* n. sp. *a*, forewing; *b*, dorsal aspect of male cauda; *c*, lateral aspect of male cauda; *d*, lateral aspect of female cauda.

the genae and in the very large wings. It is perhaps close to *T. vanuae* Kirkaldy, but I have seen no specimens of that species.

Trioza propria n. sp.

Fig. 3

Length to tip of folded wings, 3 mm.

Color: Head and thorax light brown dorsally, remainder of thorax orange. Abdomen chocolate-brown dorsally, yellow ventrally. Genae creamy white. Legs very light tan. Wings milky.

Structure: Almost glabrous, very small setae scattered over body. Head slightly wider than thorax. Postocular area large. Vertex with 2 deep longitudinal sulci, caudal margin sharp, upraised, cephalic margin rounded down, bulgingly produced each side of medial suture. Eyes large, hemispherical. Genal processes short, about one-third as long as vertex, acute, somewhat divergent apically, not completely covering frons at base. Antennae only slightly longer than width of head. Thorax quite flat longitudinally, very strongly arched laterally. Pronotum depressed far below vertex and mesonotum. Forewings about three times as long as wide; branching of basal vein in only specimen at hand not quite trifurcate, media and cubitus with short petiole, Rs smoothly curved to costa, cubital cell larger than medial. Hind wings 0.6 as long as forewings. Metatibiae with basal carina, 1 outer and 2 inner apical spines.

Female genital segment large; ventral valve larger than dorsal, blunt, dorsal acute, darkened apically.

Holotype female, Marianna Islands: Soñg-soñg-Regusa, Pagan, April 28, 1940, Yasu. et Yoshi. Type returned to Esaki.

The genal processes of this unique specimen are reminiscent of those of *Neotriozella* although much shorter. The presence of only two inner apical spines on the metatibiae is rather uncommon in the species known from the Pacific.

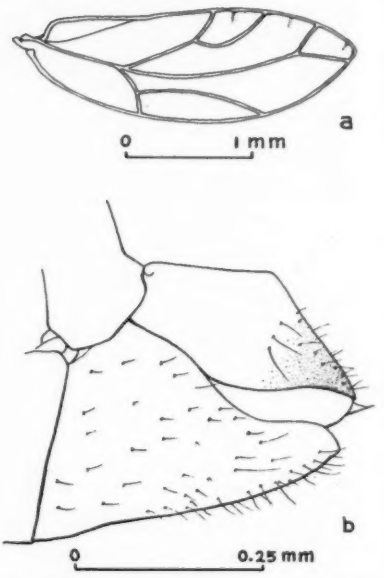

FIG. 3. *Trioza propria* n. sp. *a*, forewing; *b*, lateral aspect of female cauda.

Trioza lyra n. sp.

Fig. 4

Length to tip of folded wings, 3.25 mm.

Color: General color yellow. Incomplete longitudinal brown line medially on mesoscutum and scutellum. Metascutellum nearly white except for large brown Ω-shaped or lyre-shaped spot. Abdomen with narrow brown vitta dorsally, sternites light brown. Eyes red. Antennal segments dark apically.

Structure: Body moderately pubescent throughout. Head as wide as thorax, postocular area small. Vertex emarginate and very abruptly margined caudad, with very prominent discal circular fovea each side of medial suture, latter very prominent, anterior margin bulging, rounded down to genae. Genal processes one-half as long as vertex, broadly rounded. Eyes large, hemispherical. Antennae almost twice as long as width of head. Thorax moderately arched. Pronotum depressed far below vertex and prescutum.

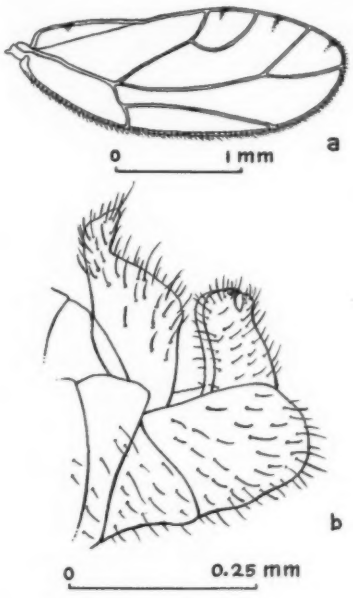

FIG. 4. *Trioza lyra* n. sp. *a*, forewing; *b*, lateral aspect of male cauda.

Forewings 2.5 times as long as wide, rounded apically; Rs rather long, reaching furcation of media, slightly arched to costa, marginal cells about equal. Hind wings two-thirds as long as forewings. Legs rather heavily pubescent. Metatibiae with small basal spur, 1 outer and 2 inner apical spines.

Male genitalia of moderate size. Proctiger long, produced caudad, excavate before apex as figured. Forceps one-half as long as proctiger; in lateral view broad, straight, with deep apical notch forming 2 teeth as figured; in caudal view slender, nearly straight to incurving black tips.

Holotype male, Caroline Islands: Nipit-Ronkiti, Ponape, January 14, 1938. One very teneral female bearing the same data accompanies the male. No information is available as to host plant or habits. Type in author's collection.

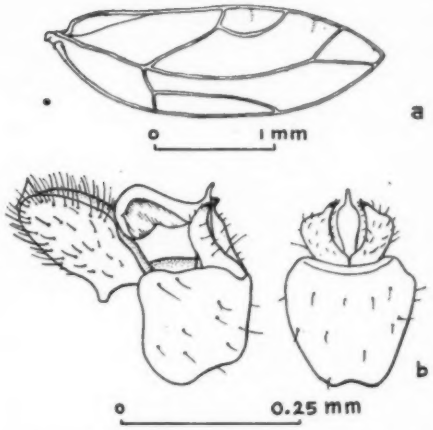

FIG. 5. *Trioza disjuncta* n. sp. *a*, forewing; *b*, lateral and caudal aspects of male cauda.

As with the preceding and following species the relationships of this form are not clear inasmuch as the triozine fauna of the area is so incompletely known.

The specific epithet refers to the marking on the metascutellum.

Trioza disjuncta n. sp.

Fig. 5

Length to tip of folded wings, 3.25 mm.

Color: Uniformly light brown, except eyes red, wings hyaline.

Structure: Long sparse pubsecence on body. Head narrower than thorax. Vertex sharply margined caudally, impressed discally each side of medial suture, bulging anteriorly. Genal processes broadly rounded, slightly over one-half as long as vertex. Antennae short, 1.7 times as long as width of head. Thorax strongly arched. Pronotum not depressed, strongly descending to level of vertex. Forewings slender, sharply angled; three times as long as wide; Rs short, curving to costa, marginal cells equal. Hind wings small, one-half as long as forewings. Metatibiae with serrate basal carina, 1 outer and 3 inner apical spines.

Male genitalia very small, distinctive in

structure as figured; aedeagus, especially, different from usual type.

Holotype male, Palau Islands: Ngarumsukan-Kaishar, Babeldaob, August 14, 1939. Type returned to Esaki.

Trioza indigena n. sp.

Fig. 6

Length to tip of folded wings, 3.25 mm.

Color: Entire dorsum brown, including dorsal portion of folded wings, except for medial yellow spot on pronotum extending as paler line onto vertex and prescutum. Ventral half of body much lighter brown to green.

Structure: Generally pubescent. Head narrower than thorax. Vertex deeply emarginate caudally, prominent discal impression each side of medial suture, at sides smoothly continuous with genae, small protuberances over median ocellus. Antennae far down on genae below line of ocellus, genal processes beyond antennae small, divergent, conical. Antennae slender, 2.5 times as long as width of head. Thorax rather flat for genus. Pronotum vertical, depressed slightly below plane of vertex. Forewings bluntly angulate, 3 times as long as wide, maculate as shown in Figure 6; R_1 very short, Rs arched to costa, marginal cells small, equal. Metatibiae with serate basal carina, 1 outer and 3 inner very large apical spines. Metacoxae somewhat produced anteriorly, meracanthi large, sharp.

Male genital segment small. Proctiger strongly produced caudad. Forceps slightly longer than proctiger; in lateral view slender, somewhat sinuate to black apex (see Fig. 6*b*), in caudal view tapering from broad base, slightly arched, apices not touching. Female genital segment large; dorsal valve slightly longer than ventral, both slender, nearly straight, acute; tips blunt, brown.

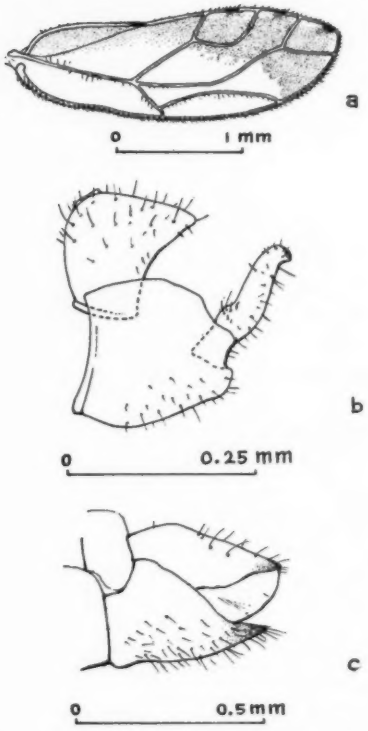

FIG. 6. *Trioza indigena* n. sp. *a*, forewing; *b*, lateral aspect of male cauda; *c*, lateral aspect of female cauda.

Holotype male, allotype female, 7 male and 2 female paratypes, Caroline Islands: Sankakuyama-Kolonia, Ponape, July 15, 1939. Type in author's collection.

This very distinctive species forms small galls on the leaves of *Elaeocarpus Kusanoi* Koidzumi, an endemic tree of Ponape. Dr. Esaki has suggested that perhaps it represents a distinct genus but, although it is markedly different from other species of *Trioza* known from the area, it fits well within the generic limits.

Plant Records from Aur Atoll and Majuro Atoll, Marshall Islands, Micronesia. Pacific Plant Studies 9[1]

HAROLD ST. JOHN[2]

PREVIOUS TO WORLD WAR II, the collections of plants from the Marshall Islands were so few and so local that the flora had not even been well sampled. Since the American occupation of the islands, several botanists have visited various of the islands and made plant collections. Nevertheless, the published data on the flora are very meager and include nothing concerning Aur and Majuro Atolls. The known flora of the Marshall Islands is summarized in Kanehira (1935), though he includes only part of the species recorded from Jaluit by Koidzumi (1915) and, of course, none of those subsequently listed from Jaluit by Okabe (1941).

In December, 1945, the writer was leader of a party of scientists from the University of Hawaii which made a scientific reconnaissance of the Marshalls and other parts of Micronesia. The trip was made possible by the United States Navy, which provided travel by airplane and boat and other facilities.

On December 17, 1945, the party visited Aur Atoll, traveling by sea plane and landing on the lagoon. After ferrying ashore in native canoes, the group had 3 hours available for collection and study of the flora on Tabal, one of the inhabited islets of that atoll.

On December 18 to 19, 1945, by L. C. I. ship, a visit was made in Majuro Atoll to Majuro Islet, a large, inhabited islet on the west side of the lagoon. On both islets native informants were employed, and from them were learned the vernacular names of the plants collected. All native plants and about half of the introduced cultivated ones and half of the adventives were known to the inhabitants by Marshallese vernacular names. These were recorded as they sounded to the observer in American phonetic rendering, just as the vocabulary of Pingelap was recorded. The explanation of the vowel sounds used in both areas is given in the report on the flora of Pingelap by St. John (1948: 99). The decision not to use the alphabet of the current U. S. Navy *Dictionary* (1945) was deliberate, due to dissatisfaction with the complexity of its vowels and the paucity of its consonants. Nearly all of these native vernacular names are here recorded for the first time, since Koidzumi, in his account of the vegetation of Jaluit Atoll, recorded as common names only the Japanese names. Later, Okabe (1941), writing also of Jaluit, recorded 21 Marshallese vernacular names, but only 18 apply to species in the present list and several are obviously different names.

The specimens collected by the University of Hawaii Expedition are deposited in the Bishop Museum, Honolulu.

In the following list the native plants are printed in bold-face roman type, while the adventive weeds and cultivated exotics are in bold-face italics.

[1]This is the ninth in a series of papers designed to present descriptions, revisions, and records of Pacific island plants. The preceding papers were published as *Bernice P. Bishop Mus., Occas. Papers:* 17(7), 1942; 17(13), 1943; 18(5), 1945; *Amer. Fern Jour.* 35: 87–89, 1945; *Torrey Bot. Club, Bul.* 73: 588, 1946; *Pacific Sci.* 2: 96–113, 1948; 2: 272–273, 1948. Manuscript received February 8, 1950.

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POLYPODIACEAE

Asplenium nidus L.

Majuro Atoll, Majuro Islet: epiphytic near base of tree trunks, *St. John 21,410;* "kartĕp."

Nephrolepis acutifolia (Desv.) Christ

Majuro Atoll, Majuro Islet: epiphytic on base of tree trunk, *St. John 21,409;* "anŭmkarere."

Polypodium Phymatodes L.

Aur Atoll, Tabal Islet: on bases of *Cocos* trees, *St. John 21,379;* "kino."

Majuro Atoll, Majuro Islet: observed; called "kino."

More recently this species has been reclassified as *Microsorium Scolopendria* (Burm.) Copeland, in Gen. Fil. 195, 1947. The writer has not yet made the tests necessary to a decision on the validity of the numerous fragments separated from *Polypodium* as genera.

PSILOTACEAE

Psilotum nudum (L.) Griseb.

Majuro Atoll, Majuro Islet: on wet mossy rock, *St. John 21,426;* "mal dŏk" (=to lean toward me), "băng." Rare; the vernacular names known to only a very few old people.

CYCADACEAE

Cycas circinalis L.

Majuro Atoll, Majuro Islet: observed in cultivation in the village; "laugŏk."

PANDANACEAE

Pandanus carolinianus Martelli, Webbia 4(2): 400, tav. XXXIV, figs. 1–3, 1914.

Majuro Atoll: S. E. side, Aug. 26, 1944, *E. H. Bryan, Jr.* "Very good eating—[like] carrot with apricot flavor." First record for the Marshalls. Known only from the type locality on Yap Island. The general name for *Pandanus* is "bŏp."

Pandanus odoratissimus L. f., var. **novo-guineensis** (Martelli) St. John, comb. nov.

P. tectorius Soland. var. *novo-guineensis* Martelli. Webbia 4(2): 413, tav. XLIII, figs. 4–5, 1914.

Kwajalein Atoll, Ennylabegan Island, Aug. 4, 1944, *E. H. Bryan, Jr.* First record in the Marshalls; known previously from Hatzfeldthafen in German New Guinea. The name *P. tectorius* is rejected as being inadequately published.

Pandanus pulposus (Warb.) Martelli, Webbia 4(2): 409, tav. XXXVIII, figs. 1–3, 1914.

P. tectorius Soland. var. *pulposus* Warburg, in Engler's Pflanzenreich IV, fam. 9: 49, 1900.

Aur Atoll, Tabal Islet: tree 7 m.×2 dm., *H. St. John 21,371;* called "kubenan."

Type locality is in the Marshalls: "Radackinseln."; collector, *Chamisso.* Kanehira also listed it from Jaluit.

GRAMINEAE

Cenchrus echinatus L.

Aur Atoll, Tabal Islet: on sand in shade, *St. John 21,376;* called "quărămiyumŭt" (=to slow you down).

Eragrostis amabilis (L.) Wight & Arn.

Aur Atoll, Tabal Islet: common, on sand in shade, *St. John 21,378;* called "wujoĕt" (a name meaning grass, that is, any grass). Also observed on Majuro Atoll, Majuro Islet.

Lepturus repens (Forst.) R. Br.

Aur Atoll, Tabal Islet: tufted, in sand, *St. John 21,373;* "wujoĕt" (= grass).

Saccharum officinarum L.

Majuro Atoll, Majuro Islet: cultivated by house, only one variety, introduced by the Japanese from Kusaie, now rare, *St. John 21,413;* called "to."

Thuarea involuta (Forst.) R. & S.

Aur Atoll, Tabal Islet: creeping, on top of coral sand beach, *St. John 21,374;* called "wujoĕt." Also observed on Majuro Atoll, Majuro Islet.

CYPERACEAE

Cyperus javanicus Houtt.

Majuro Atoll, Majuro Islet: not collected, but observed in a swamp; called "wujoĕt in ion buil" (= marsh grass).

Fimbristylis cymosa R. Br.

Aur Atoll, Tabal Islet: in open sand by shore or in open woods near-by, *St. John 21,399;* called "wujoĭt" (=grass).

PALMAE

Cocos nucifera L.

Aur Atoll, Tabal Islet, and Majuro Atoll, Majuro Islet: not collected, but observed as abundant; called "ni."

ARACEAE

Alocasia macrorrhiza (L.) Sweet

Majuro Atoll, Majuro Islet: observed in cultivation; called "wŏt."

Colocasia esculenta (L.) Schott var. *antiquorum* (Schott) Hubb. & Rehd.

Aur Atoll, Tabal Islet: observed in cultivation in one small, wet pit.

Majuro Atoll, Majuro Islet: cultivated in swampy hollow, *St. John 21,416;* "katak" is the general name, but this variety is called "katak Majol," that is, the Marshallese variety. It has the petiole pale green with short purple streaks, the margin purplish; corm 1.5 dm. long with white flesh. The other variety was called "katak in kabelin," or the variety from the west.

Cyrtosperma Chamissonis (Schott) Merr.

Majuro Atoll, Majuro Islet: cultivated in swamp, 2–6 m. tall, petioles smooth, *St. John 21,418;* called "iarătz." Another variety, with spiny petioles, *St. John 21,417,* called "kailĭklĭk" (=spiny).

AMARYLLIDACEAE

Crinum asiaticum L.

Majuro Atoll, Majuro Islet: observed in cultivation in the village; called "kiŭp."

TACCACEAE

Tacca Leontopetaloides (L.) Ktze.

T. pinnatifida Forst.

Aur Atoll, Tabal Islet: planted commonly in shade of trees, *St. John 21,395;* called "magamŭk." Also observed on Majuro Atoll, Majuro Islet: also called "magamŭk."

MUSACEAE

Musa paradisiaca L. subsp. *sapientum* (L.) Ktze.

Aur Atoll, Tabal Islet: observed in cultivation; called "keibaran."

Majuro Atoll, Majuro Islet: observed in cultivation; called "kebrang" (the name now obsolete); currently called "benana" (=banana).

MORACEAE

Artocarpus incisus L. f. (corrected from *incisa*)

The general name for all varieties of breadfruit is "me."

Seeded Variety:

Aur Atoll, Tabal Islet: tree 15 m.×2 dm., cultivated in village, *St. John 21,381;* called "mejuan." Also observed on Majuro Atoll, Majuro Islet.

Seedless Variety:

Aur Atoll, Tabal Islet: tree 20 m.×1 m., common, especially in village, *St. John 21,380;* called "pădăthadăk."

Ficus tinctoria Forst. f.

Majuro Atoll, Majuro Islet: observed in cultivation; called "tebero" (this name said to be a foreign word).

URTICACEAE

Fleurya ruderalis Gaud.

Majuro Atoll, Majuro Islet: weedy herb in clearings, *St. John 21,407;* called "nenkŭtkŭt (=legs of the turnstone, a bird).

Pipturus argenteus (Forst. f.) Wedd.

Majuro Atoll, Majuro Islet: tree 10 m.×2 dm., bast fiber used for fishnets and fishline, *St. John 21,412;* called "armai."

AMARANTHACEAE

Gomphrena globosa L.

Majuro Atoll, Majuro Islet: cultivated ornamental, observed in the village; without a vernacular name.

NYCTAGINACEAE

Boerhavia diffusa L. var. **tetrandra** (Forst.) Heimerl.

Aur Atoll, Tabal Islet: trailing in shade, *St. John 21,384;* called "rabĭtchiragai" (=to hold on to a stone).

Bougainvillea spectabilis Willd.

Majuro Atoll, Majuro Islet: observed in cultivation in the village; without a vernacular name.

Mirabilis Jalapa L.

Majuro Atoll, Majuro Islet: observed in cultivation in the village; called "emen aur" (=the fourth hour).

PORTULACACEAE

Portulaca oleracea L.

Majuro Atoll, Majuro Islet: observed by paths.

ANNONACEAE

Annona muricata L.

Majuro Atoll, Majuro Islet: observed in cultivation in the village; called "sauer sharp" (=a pronunciation of sour sop).

LAURACEAE

Cassytha filiformis L.

Aur Atoll, Tabal Islet: vine, over bushes or trees, *St. John 21,392;* called "ganun." Also observed on Majuro Atoll, Majuro Islet; called "kanun."

HERNANDIACEAE

Hernandia ovigera L.

Majuro Atoll, Majuro Islet: tree 15 m.×2 m., top of beach, *St. John 21,429;* called "bĭngbĭng."

LEGUMINOSAE

Canavalia sericea Gray

Majuro Atoll, Majuro Islet: in sandy woods by shore, *St. John 21,430;* called "marlăp" (=large bush). This species is new to Micronesia. Later collections of it are from Ailinglapalap Atoll, *St. John & Cowan 21,707;* and from Wotje Atoll, *St. John & Cowan 22,076.* These localities are far distant from the nearest known station in Fiji. Its known distribution is shown on the accompanying map (Fig. 1).

It is worthy of note that in the revision of *Canavalia* by Piper and Dunn (1922) the key needs revision. The two well-marked species, *C. galeata* (Gaud.) H. & A. of Hawaii and *C. sericea* Gray of Polynesia, Melanesia, and Micronesia, are incorrectly keyed. They are separated as the first pair of species by the first of the two headings quoted below:

"1. Pod with two supplementary ribs close to the upper suture.
Podwith two supplementary ribs 5 mm. or more distant from the upper suture."

To be sure, Piper and Dunn note under their listing of *C. galeata,* "the pods are not described and have not been seen by the writers," but in the previous paragraph they list the reference to Rock, J. F. (*Leguminous Plants of Hawaii* 209, 1920), where the pods of *C. galeata* are described in detail. Collections now in the Bishop Museum, Gray Herbarium, U. S. National Herbarium, and the New York Botanical Garden show that on ripe pods the interval between the supplementary rib and the upper suture measures, in millimeters, 1, 2, 2, 2, 3, 3.5, 4, 4, 4, 4, 5, 6, 8, 9, 12, or from 1–12 mm. Similar measurements for *C. sericea* are: 3, 4, 4, 4, 4, 4, 5, 5, 5, 6, 6, 6, 6, 6, 6, 7, 7, 7, 8, 8, 8, 8, 9, or from 3–9 mm. The key character given by

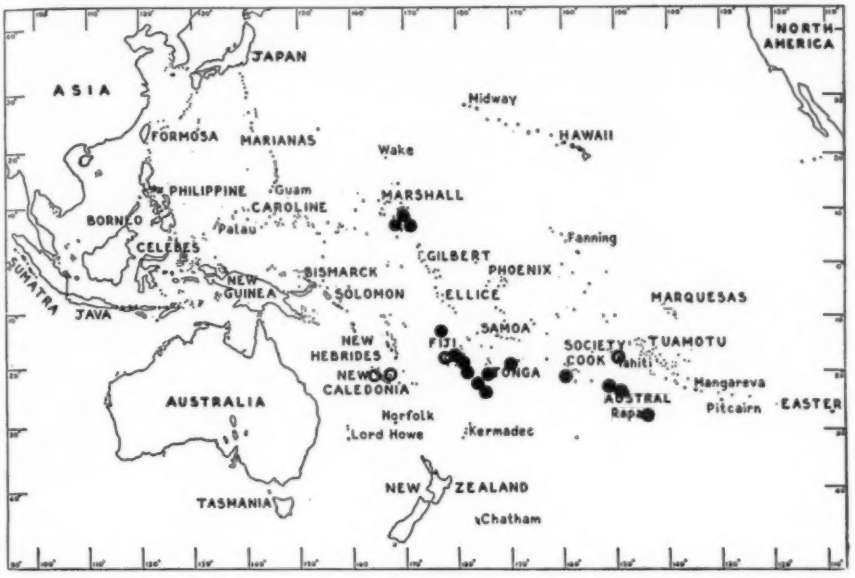

FIG. 1. *Canavalia sericea*, distribution. Round dots for localities of verified collections, reading from east to west: Rapa, Rurutu, Rimatara, Rarotonga, Niue, Nemuka, Eua, Tongatabu, Ongea Ndriti, Koro, Ovalao, Rotuma, Majuro, Wotje, and Ailinglapalap. Circles for published localities, not verified: Tahiti, Viti Levu, Lifou, and Mouac.

Piper and Dunn is (by inference) that this interval is less than 5 mm. for the two species. It is obvious, then, that the key needs revision.

Sophora tomentosa L.

Majuro Atoll, Majuro Islet: young shrub 1 m. tall, on coral sand beach, *St. John 21,428;* called "kullei."

Vigna marina (Burm.) Merr.

Aur Atoll, Tabal Islet: observed.

Majuro Atoll, Majuro Islet: on beach sands or climbing 8 m. on trees, *St. John 21,432;* called "markinejojo."

RUTACEAE

Citrus aurantifolia (Christm.) Swingle

Majuro Atoll, Majuro Islet: tree 8 m.× 2 dm., cultivated commonly in village, introduced by whites since 1900, *St. John 21,415;* called "laim" (=a pronunciation of the English word lime).

SIMARUBACEAE

Suriana maritima L.

Aur Atoll, Tabal Islet: tree 4 m. tall, *St. John 21,386;* "ngiungi."

EUPHORBIACEAE

Acalypha grandis Benth. var. ***genuina*** Muell. Arg.

Majuro Atoll, Majuro Islet: observed in cultivation in the village.

Euphorbia Atoto Forst.

Aur Atoll, Tabal Islet: tufted, *St. John 21,389;* called "perau." Also observed on Majuro Atoll, Majuro Islet, where called "peiralo."

Euphorbia heterophylla L.

Majuro Atoll, Majuro Islet: observed as a weed in the village; no vernacular name.

Codiaeum variegatum (L.) Bl.

Majuro Atoll, Majuro Islet: observed in cultivation as a hedge in the village. It had no vernacular name.

SAPINDACEAE

Allophyllus timorensis (DC.) Bl.

Aur Atoll, Tabal Islet: tree 8m.×2 dm., *St. John 21,393;* called "kudăk." Also observed on Majuro Atoll, Majuro Islet, where called "kutăt."

TILIACEAE

Triumfetta procumbens Forst. f.

Aur Atoll, Tabal Islet: common in woods near beach, *St. John 21,397;* called "ădăt." Also observed on Majuro Atoll, Majuro Islet, where it has the same vernacular name. The bast fiber is used in plaiting.

MALVACEAE

Hibiscus rosa-sinensis L.

Majuro Atoll, Majuro Islet: observed in cultivation in the village, where called "roz" (=a pronunciation of the English name rose).

Hibiscus tiliaceus L.

Aur Atoll, Tabal Islet: observed near a moist pit. The native name is "loo."

Majuro Atoll, Majuro Islet: tree forming thicket 7 m. tall, *St. John 21,405;* called "lowau." Bast fiber used for mats.

Gossypium barbadense L.

Majuro Atoll, Majuro Islet: observed in cultivation in the village; the vernacular name "kotin" (=a pronunciation of cotton).

Sida fallax Walp.

Aur Atoll, Tabal Islet: observed; called "keo."

Majuro Atoll, Majuro Islet: observed; called "guio."

GUTTIFERAE

Calophyllum Inophyllum L.

Aur Atoll, Tabal Islet: tree 8 m.×3 dm., *St. John 21,372;* called "luĕt," and "luĕs." Also observed on Majuro Atoll, Majuro Islet, where called "luguĕtz."

LYTHRACEAE

Pemphis acidula Forst.

Majuro Atoll, Majuro Islet: tree 8 m.× 3 dm., *St. John 21,427;* called "kungi."

CARICACEAE

Carica Papaya L.

Aur Atoll, Tabal Islet: in common cultivation in the village; called "keinabu."

Majuro Atoll, Majuro Islet: in common cultivation in the village; called "keinapu."

RHIZOPHORACEAE

Bruguiera conjugata (L.) Merr.

Aur Atoll, Tabal Islet: tree 6 m. tall, rare, at edge of swampy excavation in forest, *St. John 21,398;* called "shon."

Majuro Atoll, Majuro Islet: edge of swampy *Cyrtosperma* patch, *St. John 21,406;* called "jung."

COMBRETACEAE

Terminalia litoralis Seem.

Majuro Atoll, Majuro Islet: young tree, branches horizontal, *St. John 21,431;* called "kugung."

ONAGRACEAE

Jussiaea suffruticosa L. var. ***ligustrifolia*** (HBK.) Griseb.

Majuro Atoll, Majuro Islet: observed as a weed in wet garden plots; without a vernacular name.

ARALIACEAE

Nothopanax Scutellaria (Burm. f.) Merr.

Majuro Atoll, Majuro Islet: observed as a common hedge in the village; without a vernacular name.

Polyscias Guilfoylei (Bull) Bailey

Majuro Atoll, Majuro Islet: observed in cultivation in the village as a hedge.

UMBELLIFERAE

Centella asiatica (L.) Urban

Aur Atoll, Tabal Islet: sandy flat by house,

introduced weed in village, *St. John 21,375;* called "nargo." Also observed on Majuro Atoll, Majuro Islet, where called "marigo."

APOCYNACEAE

Ochrosia oppositifolia (Lam.) K. Schum.
O. parviflora (Forst.) Henslow
Aur Atoll, Tabal Islet: tree 15 m.×2 dm., *St. John 21,388;* called "kujebara."

Plumeria acuminata Ait.
Aur Atoll, Tabal Islet: ornamental trees, observed in cultivation in the village; called "mei ria."
Majuro Atoll, Majuro Islet: common ornamental tree, cultivated; called "meria." The vernacular names are contractions of *Plumeria*.

ASCLEPIADACEAE

Asclepias curassavica L.
Majuro Atoll, Majuro Islet: observed, cultivated as an ornamental in the village; called "ialu" (=a pronunciation of yellow).

CONVOLVULACEAE

Ipomoea Batatas L.
Majuro Atoll, Majuro Islet: cultivated, rare, introduced by the Germans. Tuber 1.5 dm. long, flesh white, *St. John 21,414;* called "juweet potato" (=sweet potato).

Ipomoea gracilis R. Br.
Majuro Atoll, Majuro Islet: vine, climbing 2–3 m., *St. John 21,411;* called "marginejojo."

Ipomoea pes-caprae (L.) Roth
Majuro Atoll, Majuro Islet: common on or near the beaches; called "marginejojo."

Ipomoea tuba (Schlecht.) Don
I. grandiflora sensu Jacq., non L. f.
Aur Atoll, Tabal Islet: trailing or climbing high on trees, *St. John 21,385;* called "marabele" (=white man's or foreign necklace). Also observed on Majuro Atoll, Majuro Islet; called "marabele."

BORAGINACEAE

Cordia subcordata Lam.
Majuro Atoll, Majuro Islet: tree 10 m.× 4 dm., wood used for timber, *St. John 21,408;* called "kono."

Messerschmidia argentea (L. f.) I. M. Johnston
Tournefortia argentea L. f.
Aur Atoll, Tabal Islet: tree 7 m.×2 dm., common near outer beach, *St. John 21,390;* called "krĭn." Also observed on Majuro Atoll, Majuro Islet, where called "kurĭn."

VERBENACEAE

Premna integrifolia L.
Majuro Atoll, Majuro Islet: native tree, observed; called "kar."

LABIATAE

Ocimum sp.
Majuro Atoll, Majuro Islet: aromatic herb, observed in cultivation; called "katarin" (=Catharine).

ACANTHACEAE

Hemigraphis reptans (Forst.) T. Anders.
Majuro Atoll, Majuro Islet: trailing in shade, only in village, *St. John 21,433.* It has no native name and was probably introduced, perhaps by the natives.

RUBIACEAE

Guettarda speciosa L.
Aur Atoll, Tabal Islet: tree 8 m.×2 dm., *St. John 21,387;* called "wudilonaro" (=flower of the bush).
Majuro Atoll, Majuro Islet: observed; called "wŭt."

Hedyotis biflora (L.) Lam.
Oldenlandia biflora L.
Majuro Atoll, Uliga Islet: erect, forming colonies 1 m. in diameter, *St. John 21,370.*

Ixora carolinensis (Val.) Hosokawa var. ***typica*** Fosberg

Majuro Atoll, Majuro Islet: observed. Apparently cultivated; called "gajiru."

Morinda citrifolia L.

Aur Atoll, Tabal Islet: shrub 3 m. tall, *St. John 21,394;* called "nin." Also observed on Majuro Atoll, Majuro Islet; called "nin."

CUCURBITACEAE

Cucurbita Pepo L.

Majuro Atoll, Majuro Islet: observed, commonly cultivated for food, near the houses; called "pămki" (=a pronunciation of pumpkin).

Lagenaria siceraria (Molina) Standl.

L. leucantha (Duch.) Rusby

Aur Atoll, Tabal Islet: cultivated near house, *St. John 21,377;* called "pangi" (=a pronunciation of pumpkin). Introduced by the members of the Rurick voyage under Capt. Kotzebue in 1817, and perhaps not previously cultivated by the natives.

GOODENIACEAE

Scaevola frutescens (Mill.) Krause

Aur Atoll, Tabal Islet: shrub, mostly near the sea beach, *St. John 21,391;* called "gunnat." Also observed on Majuro Atoll, Majuro Islet; called "kunnat."

COMPOSITAE

Wedelia biflora (L.) DC.

Aur Atoll, Tabal Islet: sprawling shrub, *St. John 21,396;* called "marijětch." Also observed on Majuro Atoll, Majuro Islet; called "marijatch."

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UNITED STATES NAVY, 14th NAVAL DISTRICT, DISTRICT INTELLIGENCE OFFICE. 1945. *Marshallese-English and English-Marshallese dictionary.* 1: xxx+136 pp.; 2: 1–121.

Note on the Feeding Habits of the Giant White Marlin of the Pacific[1]

On June 22, 1950, an 851-pound white or silver marlin, *Makaira marlina* (Jordan and Hill), was brought into the Kyodo Fishing Co., Ltd., at Honolulu as part of the commercial catch of the long-line fishing boat "Monarch." The specimen had been cut in two about midway between the operculum and the caudal fin as is common practice aboard local long-line vessels to facilitate stowage of large fish. It was noted in this particular specimen, however, that the stomach and part of the large intestine had been torn appreciably, leaving a sizable gap in the abdominal cavity. According to information given by Shigeo Yamaguchi, captain of the fishing boat, the marlin was caught on one of the long lines, at a depth of about 60 fathoms, during fishing operations off Hana, Maui. When the fish was brought aboard it was observed that the abdomen was abnormally swollen, and upon cutting the fish for stowage, a big-eyed tuna (*Parathunnus sibi*) was found lodged in the stomach. The tuna had been caught on the long line first, for the hook still was set in the tuna's mouth when the specimen was removed from the stomach of the marlin. The marlin evidently had found the hooked tuna an easy prey and swallowed it head-first. It appears that the latter is a common feeding practice of the large spearfishes as noted by Nakamura (*Science of the Seas* [Kaiyo no Kagaku] 3(10), October, 1943). The tuna was removed from the stomach, and, since little digestive action had taken place, it was stowed as part of the catch.

When brought into the market, the tuna was found to weigh 158 pounds, although the anterior portion of the head was missing, having been cut off when the marlin was sectioned. It measured 1373 mm. in length from the posterior margin of the orbit to the cartilaginous part of the median caudal rays. From the two pieces of the marlin, an approximate length of 2994 mm. was obtained, as measured from the naris anteriorly to the median rays of the caudal fin posteriorly.

Although it has been previously noted (Nakamura, *op. cit.*) that the giant spearfishes can easily swallow adult skipjack, this is believed to be the largest single food item recorded for this group of fishes.—*Fred C. June, Pacific Oceanic Fishery Investigations, U. S. Fish and Wildlife Service, Honolulu, Hawaii.*

[1]Published by permission of the U. S. Fish and Wildlife Service.

News Notes

The following publications of the Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers, Tokyo, Japan, have been received. Each report includes a list of all of the reports previously published, their distribution, and rules for obtaining them.

Reconnaissance Soil Survey of Japan. Nagoya Area, by Ellis J. Kohler. Report No. 110-F. 76 pp., 6 figs., 20 tables, 9 maps.

Metallurgical Plants of Japan, by Joseph E. Hersch and Robert L. Kidd. Report No. 137. 71 pp., 14 figs., 20 tables.

Japanese Offshore Trawling, by Francois Bourgois. Report No. 138. 60 pp., 31 figs., 14 tables.

Bentonite and Bleaching Clay in Japan, by Donald E. Lee. Report No. 139. 28 pp., 9 figs., 4 tables.

Safety in Japanese Coal Mines, by Charles S. Merriam. Report No. 140. 32 pp., 24 figs.

Fisheries Research Program of Japan, by Willis H. Rich. Preliminary Study No. 42. 40 pp. Mimeographed.

Management of Private Coniferous Forests of Japan, by Joseph C. Kircher and Albert K. Dester. Preliminary Study No. 43. 30 pp., 6 figs. Mimeographed.

Refractory Silica Resources of Japan, by Hideshiro Hasegawa. Preliminary Study No. 44. 29 pp., 3 figs., 15 tables. Mimeographed.

Forest Insect Control in Japan, by R. L. Furniss. Preliminary Study No. 45. 32 pp., 1 fig. Mimeographed.

Scientists in Honolulu recently enjoyed four stimulating lectures given by Dr. Linus J. Pauling, head of the Department of Chemistry and Chemical Engineering and Director of the Crellin Laboratories at the California Institute of Technology, Pasadena, California. Dr. Pauling discussed the structure of protein molecules in general and of hemoglobin in particular, the nature of antibodies and of antigen-antibody reactions, and the valence of metals in intermetallic combinations.

The Secretary-General of the South Pacific Commission, Mr. W. D. Forsyth, has informed Commissioners of his wish to relinquish the post of Secretary-General and to return to Australia before June 30 of this year. His extended leave from the Australian External Affairs Service expires this year. During Mr. Forsyth's term as Secretary-General the main lines of organization have been laid down, the work program launched, a full cycle of meetings completed of the Commission and its auxiliary bodies (the Research Council and the South Pacific Conference), staff recruited, and the headquarters of the Commission established at the permanent site at Anse Vata, Noumea. — *South Pacific Commission Press Release.*

Dr. J. Harlan Johnson, Professor of Geology at the Colorado School of Mines, is currently collecting and studying coralline algae in the Trust Territory and Okinawa for the island mapping program of Pacific Geologic Surveys Section, Military Geology Branch, United States Geological Survey. While at the Tokyo office headquarters, he will confer with Japanese specialists in this field. Dr. Johnson plans to be in the Pacific Area for four months during this summer and, following his return to Colorado School of Mines, will continue systematic study of fossil algae collections and Pacific Island limestones.

Books Received:

FREEMAN, OTIS W., Editor. *Geography of the Pacific.* ix + 573 pp., 156 figs. John Wiley & Sons, Inc., New York, and Chapman and Hall, Limited, London. 1951. $10.00.

CARSON, RACHEL L. *The Sea Around Us.* vii + 230 pp. Oxford University Press, New York. 1951. $3.75.

ALLAN, JOYCE. *Australian Shells.* xix + 470 pp., 44 pls., 112 figs. Georgian House, Melbourne. 1950. $7.50.

pasted on proper page, and point of insertion should be clearly indicated.

Original copy and one carbon copy of manuscript should be submitted. The author should retain a carbon copy. Although due care will be taken, the editors cannot be responsible for loss of manuscripts.

Introduction and summary. It is desirable to state the purpose and scope of the paper in an introductory paragraph and to give a summary of results at the end of the paper.

Dictionary style. It is recommended that authors follow capitalization, spelling, compounding, abbreviations, etc., given in *Webster's New International Dictionary* (unabridged), second edition; or, if desired, the *Oxford Dictionary*. Abbreviations of titles of publications should, if possible, follow those given in U. S. Department of Agriculture *Miscellaneous Publication* 337.

Footnotes. Footnotes should be used sparingly and never for citing references (see later). When used, footnotes should be consecutively numbered by superior figures throughout the body of the paper. Footnotes should be typed in the body of the manuscript on a line immediately below the citation, and separated from the text by lines running across the page.

Citations of printed sources. All references cited should be listed alphabetically by author at the end of the paper, typed double-spaced. References to books and to papers in periodicals should conform to the following models:

BATZO, RODERICK L., and J. K. RIPKIN. 1849. *A treatise on Pacific gastropods.* vii + 326 pp., 8 figs., 1 map. Rice and Shipley, Boston.

CRAWFORD, DAVID L. 1920*a*. New or interesting Psyllidae of the Pacific Coast (Homop.). *Ent. News* 31 (1): 12–14.

——— 1920*b*. Cerotriosa (Psyllidae, Homoptera). *Hawaii. Ent. Soc., Proc.* 4 (2): 374–375.

ROCK, JOSEPH F 1916. The sandalwoods of Hawaii; a revision of the Hawaiian species of the genus *Santalum*. *Hawaii Bd. Commrs. Agr. and Forestry, Div. Forestry Bot. Bul.* 3: 1–43, 13 pls.

In the text, sources should be referred to by author, date, and page, as follows: "It was noted (Rock, 1916: 18) that . . ." or "Rock (1916: 21–24) says . . ."

Quotations. Quoted matter of fewer than five printed lines (about 200 characters) should be given in the text in the usual form, using double quote marks. Longer quotations should be set flush with left margin. The author is responsible for the accuracy of quoted material.

Numbers. Decimals, measurements, money, percentages, time; enumerations in which any figure is 10 or over; and isolated enumerations of 10 and over should be given in Arabic figures, rather than spelled out, except when the number begins a sentence.

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Illustrations should accompany manuscript, on separate sheets. Often more valuable than a photograph is a good line drawing, which may be reproduced by the zinc etching process.

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It is strongly urged that an indication of scale be incorporated as a part of all drawings in which magnification and size are critical considerations.

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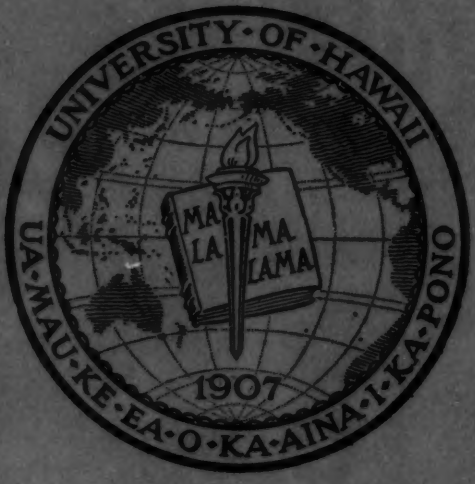
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